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Operations Analysts of the Future

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In This Issue:

- *New MORS Website*
- 83rd Symposium
- Analytic Wargaming

Report Documentation Page

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IN THIS ISSUE

MORS/MAS

2 ..... MORS President
5 ..... MAS President
9 ..... 2015 MORS Fellows
10 ..... Harnessing Technology to Serve Our Members
11 ..... The New WWW.MORS.ORG
14 ..... Building the New MORS Document Repository
15 ..... 83rd Symposium Planning Update
17 ..... Wargaming: 2014 -2015 MORS Wargame CoP Brown Bag Lecture Series
18 ..... Industry Showcase
20 ..... MORS Junior Analyst Program: A Personal Insight

PROFESSIONAL FEATURES

22 ..... DOD's Role in Network Science
28 ..... Analytic Wargaming on the Rise
33 ..... Practical VV&A for DIME/PMESII Models
40 ..... The Challenge of Integrated Space Analysis
42 ..... Thoughts on Participating in a Professional Dialogue

IN TOUCH

45 ..... MORS Heritage 2005-2007
48 ..... Young Analyst: Alex Trempe
49 ..... The PuzzlOR & Thinking Analytically
50 ..... Member Milestones
52 ..... Pseudo-Analytical Agenda

SPONSOR'S CORNER

54 ..... 52nd Army Operations Research Symposium

LAST WORD

60 ..... Guest Editorial – Jim Bexfield Some Thoughts on Working with the International Community

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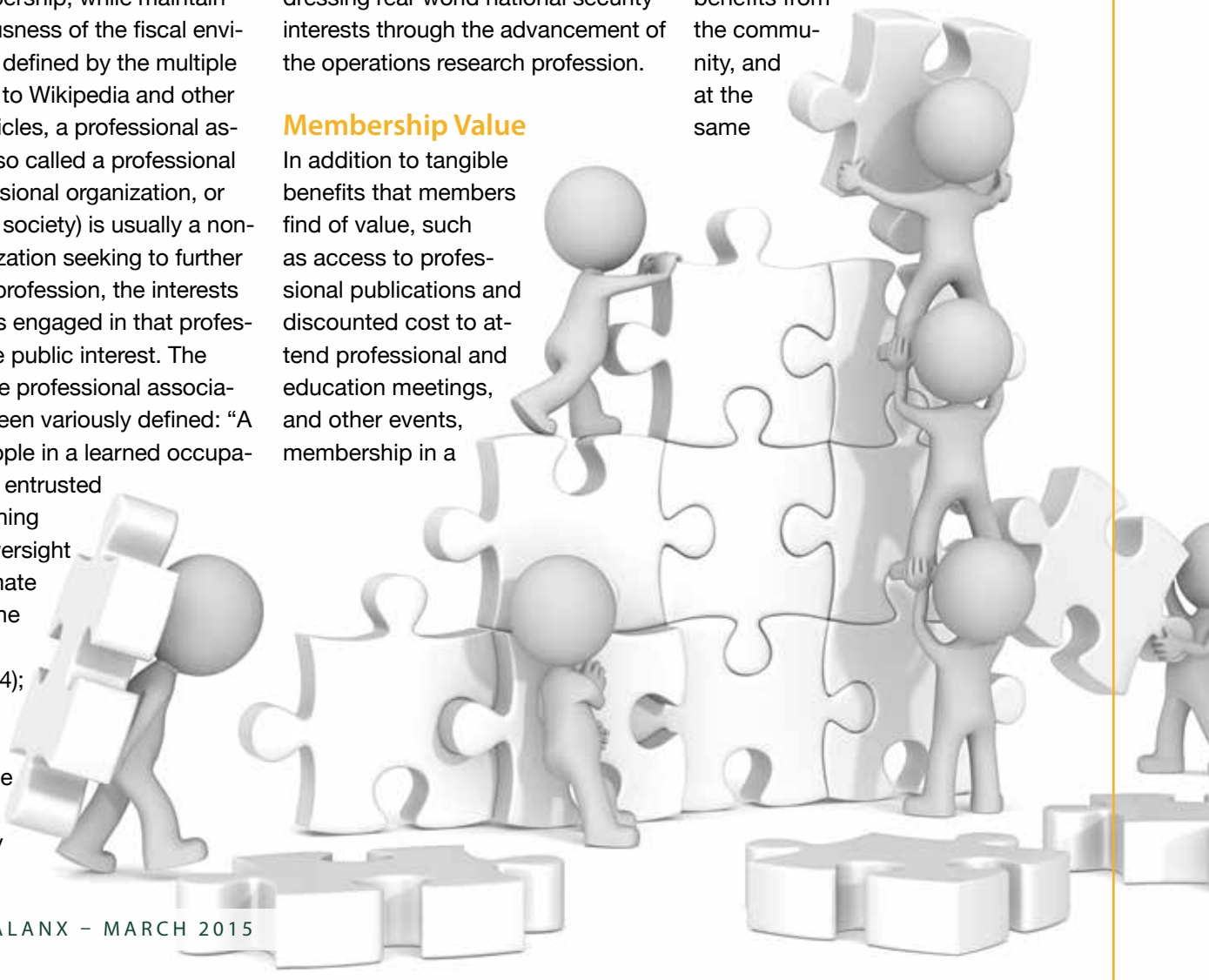
The Making OF A Professional Society

MORS, as a professional society, has continuously devoted its growth to the needs and demands of its members. This results in a persistent, adaptable evolution to fine tune itself to the best interest of our membership, while maintaining consciousness of the fiscal environment. As defined by the multiple contributors to Wikipedia and other scholarly articles, a professional association (also called a professional body, professional organization, or professional society) is usually a nonprofit organization seeking to further a particular profession, the interests of individuals engaged in that profession, and the public interest. The roles of these professional associations have been variously defined: "A group of people in a learned occupation who are entrusted with maintaining control or oversight of the legitimate practice of the occupation" (Harvey, 2004); also a body acting "to safeguard the public interest;" (Harvey et al., 1995); organizations which "represent the interest of the professional practitioners," and so "act to maintain their own privileged and powerful position as a controlling body" (Harvey et al., 1995). The mission of the Military Operations Research Society is to enhance the quality of analysis addressing real-world national security interests through the advancement of the operations research profession.

Membership Value

In addition to tangible benefits that members find of value, such as access to professional publications and discounted cost to attend professional and education meetings, and other events, membership in a professional society offers individuals the opportunity to support or be actively involved in research, communications, and programs in their field. As such, MORS focuses its activities on empowering operations research professionals like you to obtain individual benefits from the community, and at the same



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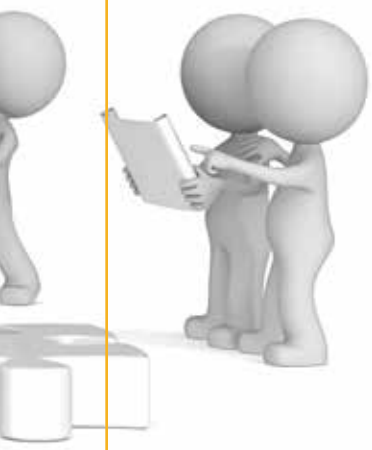
time provide you with the opportunity to contribute to the national security analytic community at large.

Some of the outlets available to members to learn and share include our meetings and conferences, which provide the opportunity to participate in and attend presentations on research in our discipline, and across other disciplines that apply our operations research toolset. This interdisciplinary interaction has evolved in recent years, providing our members and others disciplines an open forum from which we continue to enhance our awareness on the depth and breadth of the applicability of our skills.



Just recently, MORS held its third Industry Showcase on "Developing the Analytical Workforce: Shared Perspectives between Government and Industry," where we engaged in a very informative program designed to address upcoming challenges in workforce development and human capital investments. On the surface, these do not sound like topics affecting military operations research or national security. However, when we take a closer look, we realize their impacts. The discussions focused on two perspectives: First, the operations researcher's contribution in analyzing and providing insights to improve the corporate and government workforce; and second, the need to better understand and suggest ways to enhance the development and training of operations researchers to meet the analytical demands of government and industry. This gathering provided a series of distinguished speakers, panels of experts, discussions, exhibits, demonstrations, and informal interactions, presenting government, industry, and academics with an opportunity to learn from each other and share experiences in a nonattributional multifaceted forum.

Our focus this year on "Growth through Professional Development and Continuing Education" highlights the need to stay on the leading edge of our profession, allowing us to enhance the contribution to others, as the demand for analytically rigorous approaches and results continues to increase. I would like to highlight one of our premier events this year, the Education and Professional Development (EPD) Colloquium, to be held at George Mason University. The EPD Colloquium is a yearly event designed to bring together students, junior analysts, and senior professionals to provide mentoring and professional development opportunities. The steady growth of our society benefits tremendously from the exchanges that occur during this event in which we also provide outreach activities; offer a job fair where students can explore potential future employment opportunities; provide presentations of published reports, surveys, professional guides, certification opportunities, and other resources for operations research departments, authors, graduate and undergraduate students, and the professional community as a whole. This is a must-attend event every year.

As with many professional bodies, MORS is involved and committed to the development and monitoring of professional education programs, and the updating of skills. Our Continuing Education Committee is concentrating its efforts in the development of courses, tutorials, programs leading to certification, and other ways to enhance or refresh our skills in diverse areas of our profession. We are not only focusing on the hard skills required to impart analytical rigor to our work, but also on the soft skills, critical thinking, studies management, effective presentation of results, and others, that can enhance the quality and credibility of what we do. Stay tuned to future courses and tutorials that will be offered as stand-alone events, or as part of our meetings.

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As our premier annual event, please remember to lock in the dates for the 83rd MORS Symposium, which will offer the finest opportunities for professional collaboration and networking. This year our signature event is scheduled for June 22–25, 2015 at the DoD Mark Center in Alexandria, Virginia. We have received a tremendous set of terrific abstracts taking advantage of the enhanced opportunities this year to present your work at this event. Details on program specifics are available on the MORS website: www.mors.org/Events/Symposium/83rd-Symposium.

Moving Ahead: Continuing Evolution

With the 83rd Symposium we will kick off our 50th year, as a continuously evolving society, with a range of activities that I am sure will be of great interest, as we observe this major milestone. As more rigorous analysis is required to prepare and defend the shaping of our National Security interests, it is imperative that we continue to concentrate some energy on maintaining the growth of our discipline and the skills of our national security analytic professionals, both in government and nongovernment organizations. One way to achieve this is by supporting existing continuing education opportunities, and developing new ones, targeting the maintenance and enhancement of the technical competence of our members.

With an in-person and a virtual component, the 83rd Symposium will allow analysts across the national security community to share their work and collaborate with diverse and talented professionals. The MORS Symposium is a great place to not only show off completed work, but also discuss new efforts in their early stages. Colleagues with different backgrounds and experiences can often help each other think through the formulation of their problem and better assess alternate approaches and methods.

I would also like to take this opportunity to invite you to navigate through the new MORS website and membership management system. Many of you have already experienced the new site since we launched it in early December. You might have noticed not only a new look and feel, but also a tremendous enrichment in content and capability. With these new initiatives, MORS is significantly enhancing and improving services to our members and the OR community. Please look around the site and explore the MORS resource center, an all-new initiative to bring our vast library of reports, out-briefs, oral histories, articles, publications and other important documents to you with full, in-depth text search capability. As a user of this site you will find the "My MORS" section with your profile and purchase history easy to navigate. Some additional features and enhancements are still being rolled out to better serve you. As an example: your papers, presentations, and published articles, as well as MORS community participation in our volunteer leadership positions for meetings, the annual symposium, working groups, communities of practice, and others, will be linked to your permanent profile in "My MORS" for easy access in the future. Stay tuned.

Your MORS Board of Directors has been working very hard, listening to your needs, creating new value to your membership, and supporting the continuing evolution of our organization. We all are very excited to bring you these membership offerings. We are here to serve you and welcome your comments in the best interest of our discipline, the National Security analytic community, and supporting our mission to enhance the quality of analysis addressing real-world national security interests through the advancement of the OR profession. We thank you for being an integral part of our efforts.

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INFORMS 2014

As I mentioned in the last issue, I want to outline some of the happenings at the INFORMS Annual Meeting held in San Francisco in November and I will conclude with some information about operations research within the Army.

INFORMS 2014 was an exciting meeting with more than 5,000 participants, and hopefully this synopsis will inspire even more people from MAS and the military OR community to attend, present, chair, and participate in the November 2015 annual meeting in Philadelphia. The best part of being at the INFORMS meeting is getting to know your community—in this case the Military Applications Society (MAS). Whether it's the receptions, presentations, panel sessions, tutorials, or business meetings, there is always time to meet new people, reconnect with friends and colleagues, and share ideas. The career center hiring event showed that cyber, big data, and network modeling promise to be big players in the future of OR. I personally developed many new contacts and learned valuable up-to-date information from the conference and am already preparing myself for the next annual conference.

William Fox of the Naval Postgraduate School and past president of MAS chaired the overall MAS sessions with help from many session chairs, speakers, and panelists. I thank all who participated and mention below some presenters and participants. My apologies to those that I have missed.

Richard Deckro, Air Force Institute of Technology, chaired a session on analysis in support of national security. Some of the speakers in his session were Matthew Robbins, Sean Keneally, Brian Lunday, Jasmine Morgan, Michael J. Kwinn, Jr., and David Smalenberger.

Dean Hartley, Hartley Consulting, chaired two sessions on DIME/PMESII. His speakers included Jeff Appleget, Charlie Graham, Karen Guttieri, John Hummel, Paul Lewis, Ignacio Martinez-Moyana, and Philip Fellman.

Greg Parlier, MAS past president, presented tutorials on "Predictive Analytics," "Management Innovation to Transform the Department of Defense Logistics Enterprise," and a special "MAS Session on the State of Operations Research in the US Military: A 75th Anniversary Perspective." He also chaired a joint MAS/DAS session on military decision analysis applications. His speakers included Thomas Wilemain. Greg's significant historical presentation, "The State of Operations Research in the US Military: A 75th Anniversary Perspective," was summarized by, "perspectives on the past, present, and future of operations research in the US Department of Defense with emphasis on the Army. The need for a critical review is argued, and a framework for a comprehensive assessment is developed. Enduring principles are suggested, and new concepts are presented, including both strategic and transformational analytics."

Greg Parnell, University of Arkansas, chaired a session on military decision analysis applications.

William Fox, Naval Postgraduate School, chaired two sessions on mathematical modeling and operations research in military decision making. Presenting in these sessions were Tiffany Crosby, Daniel Stimpson, Rajesh Ganesan, and David Marlow, Mike Teter, Michael Jaye, and Robert Burks.

Nathaniel Bastian, PhD Student at Pennsylvania State University, chaired a session on advances in

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military healthcare operations research with many speakers including Lawrence Fulton, Pat McMurry, Paul Griffin, Tahir Ekin, Ozan Kocadagli, Benjamin Grannan, Laura McLay, Nolan Roggenkamp, and Temi Ayeni.

Aaron Burciaga, Accenture, chaired three sessions: "Analytics for New Efficiencies: Quality and Lifecycle Management in the DoD," "Analytics for Surviving Austerity: Doing More with Less," and "Analytics for the Tactical Edge: Better Business through Operations Research in the DoD." The presenters were Rodrigo Hernandez, Natalie Scala, Paul Goethals, Harpreet Toor, Maro Enoka, Randal Allen, Don Hanks, and Will Donovan.

Michael Hirsch, ISEA TEK, chaired sessions on sensors and weapons and sessions on mission planning and search theory along with Chase Murray, Auburn University, on mission planning. The outstanding speakers in these sessions included Andrew Romich, George Lan, J. Cole Smith, Emily Craparo, Mumtaz Karatas, Carl Parson, Darryl Ahner, Cleber Almeida De Oliveira, Daniel Schroeder, Alvaro Maggiar, Irina Dolinskaya, Paul Scerri, Bob Jacobs, Monali Malvankar, Siddhartha Mehta, Eduardo Pasiliao, Mike Moskal, Rajan Batta, Aaron Williams, Azar Sadeghnejad Barkousa, Moises Sudit, Rajan Batta, Hector Ortiz-Pena, Moises Sudit, Mark Karwan, Luca Bertuccelli, Francesco Leonardi, Jeffrey Peters, Amit Surana, Michael Couche, Tae Bo Jeon, David Casbeer, Michael Atkinson, Moshe Kress, Yan Xia, Rajan Batta, Rakesh Nagi, Paul Scerri, Joe Mola, Elan Freedy, and Amos Freedy.

Christopher Smith, Director, TRAC-Monterey, chaired a joint session: Social Media in Disaster Response," and "Diplomacy, Sentiment, & Social Network Analysis Using Social Media."

Jun Zhuang, University at Buffalo, chaired "Decision Analysis: Game Theory, Decision Analysis, and Homeland Security." Speakers included Thanh Nguyen, Milind Tambe, Gary Gaukler, Cen Song, and Elizabeth Paulson.

Harrison Schramm, Office of the Chief of Naval Operations, chaired a session on "New Voices in Military Operations Research," with presentations by Robert Lantz,

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Jennifer Stave, Alonzo Barnett, and Jon Roginski.

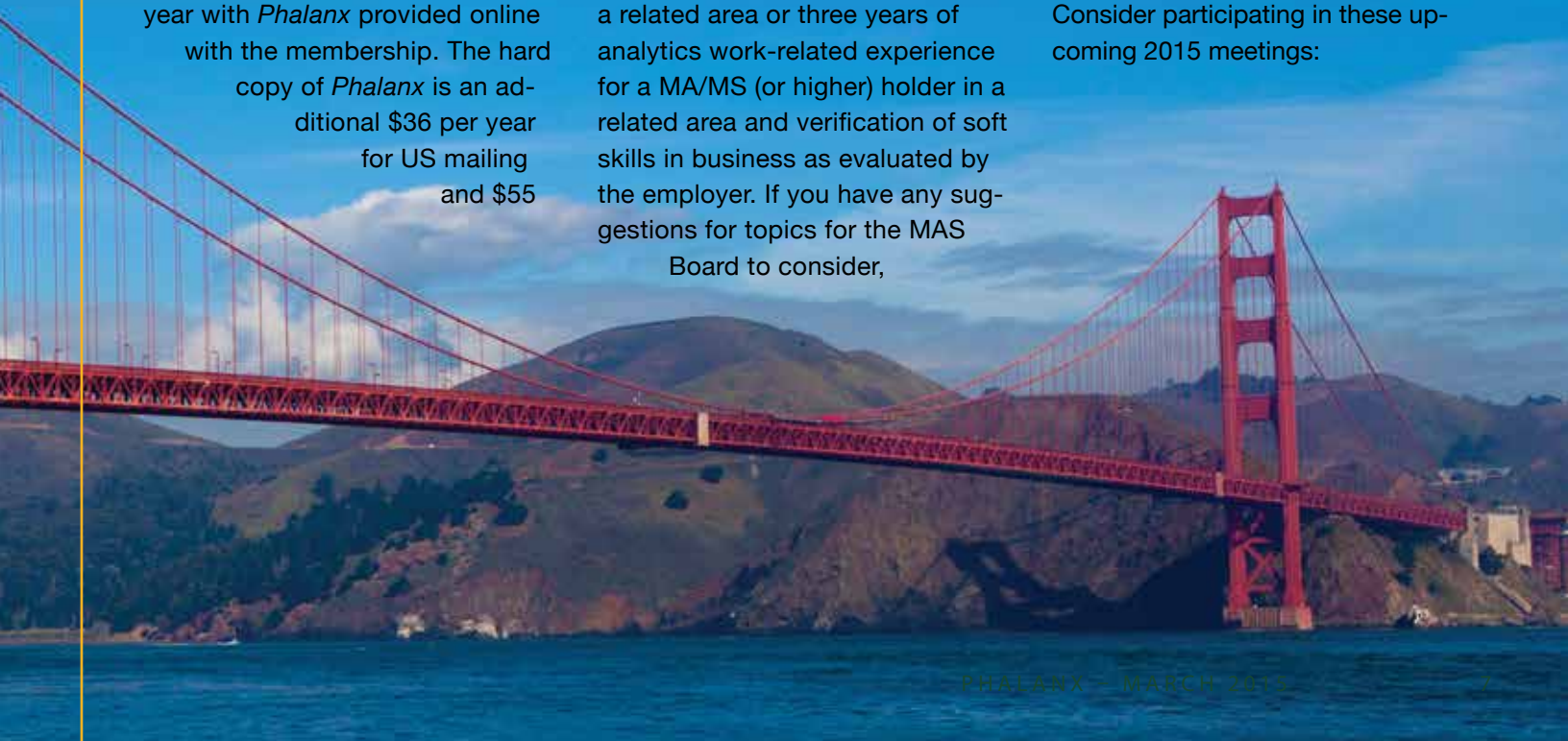
In addition to the MAS-sponsored presentations, the INFORMS conference gave attendees many wonderful opportunities for learning and sharing. I particularly enjoyed the Philip McCord Morse Lecture on "Statistics and Machine Learning via a Modern Optimization Lens" by Dimitris Bertsimas, professor of operations research and statistics at Massachusetts Institute of Technology. It is significant that over "the last twenty-five years (1990–2014), algorithmic advances in integer optimization combined with hardware improvements have resulted in an astonishing 200 billion factor speedup in solving MIO problems." The pace of our world is increasing dramatically and as OR analysts, we have our work cut out for us to keep up.

In San Francisco, our executive council meeting confirmed the plan to have our dues remain at $25 per year with *Phalanx* provided online with the membership. The hard copy of *Phalanx* is an additional $36 per year for US mailing and $55 for international mailing. The meeting also gave us resolve to use INFORMS Connect (online system) to share more information. We can all start this initiative by going online and sharing information and performing collaboration. We also discussed the possibility for new awards in education and mentoring, ways to connect with MORS, especially on education issues, and the future of the Certified Analytics Professional (CAP) Exam for MAS members. CAP is offered by INFORMS as the profession's first general analytics certification exam and can help improve analysts' job performance by stressing continuing professional development and building competence in the principles and practice of analytics. To obtain the certification, an eligible person must pass the exam and adhere to the code of ethics. Eligibility requirements include five years of analytics work-related experience for a BA/BS holder in a related area or three years of analytics work-related experience for a MA/MS (or higher) holder in a related area and verification of soft skills in business as evaluated by the employer. If you have any suggestions for topics for the MAS Board to consider, please send your ideas to me at David.Arney@usma.edu.

The general membership meeting was well attended and we were pleased to present the following awards:

- Steinhardt Prize: Dr. Ervin Kapos, who served with the Office of Naval Research and the Department of Homeland Security.
- Koopman Prize: Gerald Brown, Matthew Carlyle, and Robert Dell (Naval Postgraduate School) and John Brau, Jr (USTRANSCOM), for their article "Optimizing Intratheater Military Airlift in Iraq and Afghanistan" that appeared in *Military Operations Research.*
- Bonder Award: Jason Southerland, PhD student at George Mason.
- Outstanding Service: Walt DeGrange (outgoing secretary of MAS) and William Fox (outgoing president of MAS)

Consider participating in these upcoming 2015 meetings:



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- 2015 INFORMS Conference on Business Analytics & Operations Research, April 12–14, at the Hyatt Regency Resort & Spa, Huntington Beach, California.
- 2015 CORS/INFORMS International Conference, June 14–17, at the Le Centre Sheraton Hotel, Montreal. Greg Parlier will chair the MAS session.
- INFORMS Healthcare Conference, July 29–31 in Nashville, Tennessee.
- INFORMS Annual Meeting, November 1–4 at the Pennsylvania Convention Center and Marriott in Philadelphia.

OR in the Military Today

The military OR community continues to expand into many of the hot research areas within the field of OR. The big data challenges and questions emerging from data and network sciences have interesting applications both within the generating and operation forces of the services. The Army has placed analysts within the Army medical community as well as the Army cyber community to attempt to exploit their large datasets and to provide the decision support these areas so desperately need. Once an analyst is placed within an organization and benefits from OR contributions, there is always a request from the organization for additional analysts.

The military is also finding that the success of OR analysts in operations and campaign planning and assessment as well as programming and budget analysis does not convey the full breadth of possible military benefits of OR. Some of the military's senior leaders do not appreciate the variety of research that well-educated OR analysts are prepared to perform. The cyber organizations have large quantities of data to be analyzed and cyber modeling presents a clear big data challenge. However, we have to continue to work the connection between the big data and data science problems and the military OR community. The analysts that the Army has assigned to ARCYBER, working closely with the Center for Army Analysis, have been working on models for cyber training pipelines, but this is only the beginning of the work that can be done. Clearly, not all analysts are trained to perform all types of analysis, but as a community, the Army OR analysts have expertise that can assist in all areas of OR. The Army OR leaders and managers continue to encourage the collaboration that is facilitated by conference attendance to share the wealth of experience within the Army OR community.

The world of OR continues to move at warp speed as the information, techniques, issues, and important questions change and shift in our society. This rapid pace of change it's so valuable for analysts to attend conferences like the INFORMS annual meeting and learn first-hand about some of the changes and meet many of the people who are producing these changes. I hope to see many of you at meetings and conferences in the future.

Acknowledgments

My thanks to MAS Vice President Andy Hall for his insights on Army's use of OR.

2015 MORS Fellows

Simon R. Goerger, MORS Membership Committee Chair

Since 1989, the MORS Board of Directors (BoD) has annually recognized outstanding members of the Society for significant, long-term contributions to the Society and inducted these individuals into the ranks of the MORS Fellows. This year, MORS is pleased to recognize four members of our Society, selected in December, as MORS Fellows: Mr. "Trip" Barber, Dr. John R. Hummel, Ms. Lana E. McGlynn, and Mr. Terrance J. "Terry" McKearney.

These four individuals have contributed numerous hours of volunteer service to the Society in a multitude of ways and have provided lasting positive contributions that will continue to enhance the rolls and effects of MORS for its membership and the Nation's security. They join the 71 members of our community previously recognized with this honor (http://www.mors.org/Home/About-MORS/Fellows).

Mr. "Trip" Barber has been a member of MORS since 2002, making him the Junior Fellow of the 2015 Fellows' Class. Mr. Barber has served as the Navy MORS sponsor for over a decade and has been a vocal advocate for the Society. He was instrumental in arranging the 2007 and 2011 MORS Symposium at the Naval Postgraduate School and the Naval Academy as well as helping to build the Navy's current operations analysis community by encouraging Navy analysts to present their work at MORS at least once a tour.

Dr. John R. Hummel has been a MORS member since 2000. He has served the Society in 12 working group/composite group leadership positions, co-chair for two special meetings, and as the MORS Symposium program co-chair, chair, and advisor. He has also served as an elected and advisory member of the Board of Directors (BoD). John was also essential in establishing the Department of Energy (DoE) Argonne National Laboratory (ANL) as a major participant in MORS and as a founding member of the MORS Industry and Institutional Partnership program. John continues to serve the society as an advisory director to the MORS Board and contributes as a member on several of its committees.

A member of MORS since 1989, Ms. Lana E. McGlynn has served as the Army sponsor's representative from 1997 until 2000, a MORS registration volunteer at MORS symposia for over 24 years, and as a VIP coordinator at numerous MORS symposia. She was an elected member of the MORS board from 2000–2004 and an advisory director from 2004–2014. She has chaired three BoD committees, participated as a member of eight BoD committees, and has been on the organizing committee for four MORS workshops or minisymposiums.

Mr. Terrance J. "Terry" McKearney has been a member of MORS since 1995. Over the nearly two decades of his service to the Society, Terry has served on six WG/CG leadership positions; a synthesis group chair; a workshop co-chair; and the MORS Symposium program co-chair, chair, and advisor. He served as an elected member of the MORS board from 2006 until 2012. While on the MORS Board, Terry served as the MORS Vice President for Finance and Management and as the MORS President 2010–2011. As well as being a MORS advisory director, Terry continues to serve the Society as the editor of the *Phalanx*.

Again we thank these outstanding volunteers and operations research professionals of our Society and welcome them as the newest MORS Fellows.

Harnessing Technology to Serve Our Members

Susan K. Reardon, MORS Chief Executive Officer, susan@mors.org

On December 1, 2014 MORS launched a new technology and communications initiative, which includes a new website and member management system. The system is called NOAH and was developed by JL Systems of Annandale, Virginia. NOAH provides a more effective and technically up-to-date platform for communications with our members and improves online access for members to MORS information and resources. To achieve this, the MORS website (www.mors.org) was redesigned and reorganized and is now a responsive site that automatically adjusts to the platform you are using.

The NOAH system replaced five independent systems, saving MORS money and saving you passwords to memorize! The website is fully integrated with the membership system. When you sign on as a member you will see additional menu items appear that give you access to "member only" pages and features. The "My MORS" page is your personal record of your MORS purchases, committee, and working group membership, subscriptions, and areas of interest. As we build the system, it will include your submissions for symposium and special meeting presentations, articles, and more.

One of the most significant enhancements is the MORS Resource Center, an all-new initiative to bring our vast library of reports, out-briefs, oral histories, articles, publications, and other important documents to you with full text search capability. Still under development and coming soon are blogs, forums, and further development of our system to be a fully interactive online platform for communications and collaboration. MORS is here to serve our members and community and we are striving to do that with the best technology in the most efficient way. A special thanks to Mike Noonan for the new website design and Kirk Michealson, FS, for managing and uploading the documents to the new MORS Resource Center. Check back often to www.mors.org for updates and enhancements.

Have fun playing with the new MORS website! If you have any questions about it, please contact morsoffice@mors.org.

The New WWW.MORS.ORG

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As noted in the accompanying article by MORS Chief Executive Officer Susan Reardon, the Society recently launched a new website and resource management system designed to provide members of the national security operations analysis community access to information on MORS events and a broader range of information concerning our profession.

Figure 1

Figure 2

General/personal links	Information available
Home	Returns to the MORS homepage
About MORS	Provides the MORS mission, background, heritage, services provided, and links to key personnel
My MORS	Your user account, where you can find and update your profile, bio, addresses, communications, demographics, downloads, privacy & subscriptions, communities, donations; pay for outstanding orders; change user name; and reset password
Join	Links to join as an individual member or an industry/institutional partner
Shop	Links to join, purchase books, and subscribe to *Military Operations Research* and *Phalanx*
My Cart	Displays the description, quantity, price, and subtotal for purchases in progress

A benefit to MORS members is exclusive access to meeting reports, community reports, *Military Operations Research,* and past *Phalanx* issues. As the website organization is discussed in the next few paragraphs, the additional access MORS members have will be highlighted.

The home page has six general/personal links in the blue header; eight activity links at the top of the page in the gray bar right below the header; rotating pictures; three sections of quick links (upcoming events, MORS-related news articles, and the new resource center); links to the MORS Government Sponsors; links to the MORS Industry and Institutional Partners; Join, Contact Us, and My MORS links in the bottom blue bar; and the privacy statement and terms of use links at the bottom of the page.

For the six general/personal links in the header (Figure 1), there are links to return to the homepage, About MORS, Join, My MORS, Shop, and My Cart.

The information available through these links is listed in the table (Figure 2). Your personal data is protected through the use of encryption via the Secure Socket Layer (SSL) protocol. The full MORS privacy statement (link at the bottom of the page) discusses the MORS policy on the collection, use, and security of personal information.

There are eight MORS activity links at the top of the page in a gray bar right below the website header. Through these links, there is information available for everyone, and for some of the activities, there is additional information available for members only.

Membership Activities

- Information on membership benefits and rates, plus links to join, information on junior analysts, student members, industry and institutional partners, and sustaining contributors.

Education Activities

- Information on MORS continuing education programs, plus links to upcoming tutorials and courses, information on the next education colloquium, MORS reading list, and student webinars.

Event Activities

- List of recently completed events, plus links to the symposium page (ACP, WG charters, WG tutorials), special meetings page (list of completed events 1985–2014, special meeting tutorials, and brief summaries of completed special meetings), and educational colloquium and industry showcase page.

The events section hosts the new presenter center for symposium abstract submission, presentation and form uploads, and the reviewer center for chairs and working group members to review, rate, and select abstracts.

Figure 3

Figure 4

Figure 5

- Additional for members: Ability to search the meeting repository for completed final reports, leadership briefs, synthesis group/working group outbriefs, and other selected documents.

Community Activities

- Overview of MORS Communities

Figure 6

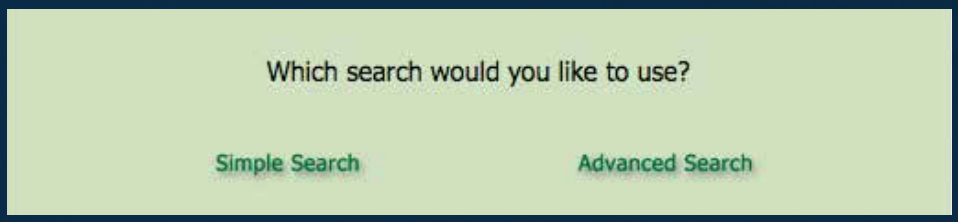
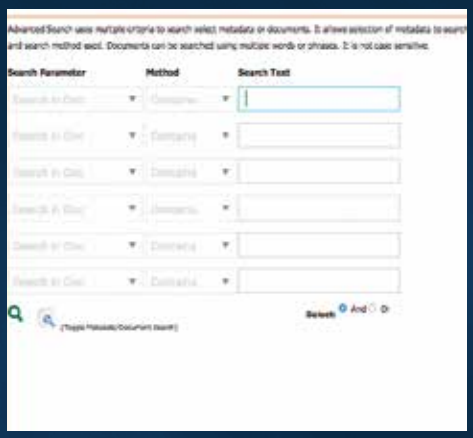


Figure 7

Figure 8



of Practice (CoP), CoP tutorials, and links to active MORS CoP pages (currently Affordability Analysis and Wargaming). The individual CoP pages provide an overview of the CoP, links to the symposium working groups and special meetings, and a calendar of upcoming CoP meetings and events.

- Additional for members: Ability to search the CoP repository for completed minutes, briefs, and other selected documents.

Publication Activities

- Information on the three types of MORS publications (i.e., books, *Phalanx* and *Military Operations Research*) and links to more information on each.
- Additional for members: Access to *Military Operations Research* and past *Phalanx* issues.

Research Activities

- The new MORS Resource Center with links to search MORS special meeting summaries, oral histories, and the MORS reading list.
- Additional for members: Ability to search for past meeting documents, CoP documents, and access to *Military Operations Research* and past issues of *Phalanx*.

Recognition Activities

- Links to MORS awards and prizes to learn more about them, the history of distinguished winners, and how to nominate for the Barchi Prize, David Rist Prize, Hughes Award, Moore Graduate Research Prize, MOR Journal Award, Rosenthal Competition, the Tisdale Prize, Thomas Award, Walker Award, and Wanner Award.

Career Activities

- This special section allows OR practitioners seeking new opportunities the opportunity to post their resumes. It also allows institutions, companies, and agencies seeking analysts to access them.

In the center of the homepage, there are three columns with quicklinks. In the left column, there are links to the upcoming events. In the center column, there are links to MORS-related news articles, messages, and announcements. In the right column, there are links to the resource center to search for MORS documents, books, periodicals, and journals.

Document Search

For each type of document search (i.e., meeting summary, oral history, meeting document, CoP document, and past *Phalanx* issues), there are two buttons:

- Full list displays the full list of the documents in the specific type of repository. In the list, you can click the column header to sort alphabetically or reverse alphabetically.
- The search feature does a full text search of documents through two different methods:
  - o Simple search: Uses a single criterion to search all metadata or documents. The criterion may be part of a word, a full word, or multiple words. It is not case sensitive.
  - o Advanced search: Uses multiple criteria to search selected metadata or documents. It allows selection of metadata to search parameter (i.e., CoP, month, document title, or year) and search method (i.e., contains, doesn't contain, starts with, and ends with). Documents can be searched with multiple words or phrases (using "and" or "or"). It is not case sensitive.

The new MORS website is organized better to quickly find the information needed, and for MORS members the new document search capability is much superior for finding previous meeting reports. Have fun playing with the new MORS website! If you have any questions about it, please contact morsoffice@mors.org.

Building the New MORS Document Repository

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As mentioned in the "Harnessing Technology to Serve Our Members" and "The New WWW.MORS.ORG" articles in this issue, MORS is creating several document repositories for MORS members. Two of the repositories are complete with all available documents uploaded and ready for members-only review.

- Communities of Practice (CoP) Repository. All CoP-related documents on the previous MORS website have been uploaded. The CoP Repository is organized by CoP name and CoP document name.
- Previous *Phalanx* repository. Thanks to MORS Fellow Lee Dick's 40th Anniversary of *Phalanx* articles and the more recent electronic versions, all available *Phalanx* issues from the first volume, first issue in 1966 have been uploaded. The *Phalanx* repository is organized by issue year and month.

Two other repositories are being populated and will take a little more time to complete. Kirk Michealson, FS, is leading the effort to build meeting summary and meeting reports/outbriefs repositories. He is trying to collect reports from all 103 special meetings in the "List of Completed Meetings" link at http://www.mors.org/Portals/23/Docs/Events/Completed%20MORS%20Meetings.pdf.

The meeting summary repository includes brief overviews of each meeting, and include which *Phalanx* issue the meeting report was published in. Meeting summaries are viewable by members and nonmembers. Hopefully, nonmembers will review the meeting summaries and want to become members to review the corresponding *Phalanx* article and other meeting reports. This repository is organized by the meeting title and year. As of mid-January:

- 26 overviews have been uploaded to the meeting summary repository, and
- 90 meetings had their meeting reports published in *Phalanx*.

The meeting reports/outbriefs repository is available to members only and consists of meeting final reports, sponsor/leadership briefs, synthesis group-working group outbriefs, and other selected files, if available. This repository is organized by year, meeting title, and document type. As of mid-January:

- 24 meetings have provided all their available documents
- 61 final reports have been uploaded,
- 28 sponsor / leadership briefs have been uploaded,
- 27 meetings provided their synthesis group-working group outbriefs, which have been uploaded, and
- 39 other files have been uploaded.

A total of 156 files have been included in the meeting report/outbriefs repository.

Coming soon to the repository will be the entire collection of the *Military Operations Research* journal, including back and current issues. The journal repository will replace the current system for online journal access for members and online subscribers and will offer individual articles for sale to others.

A Commitment to Life-Long Learning: 83rd Symposium Planning Update

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The 83rd MORS Symposium will be a unique opportunity to help you grow professionally, share your work, and develop strong relationships with a diverse and talented group of professionals. The "live" symposium will be held at the DoD Mark Center and Hilton Alexandria Mark Center in Alexandria, Virginia, June 22–25, 2015. The virtual segment of the symposium will be conducted July 22–23, 2015. The theme, "National Security Analysts: Growth through Professional Development and Continuing Education," reflects the society's commitment to helping you maintain your proficiency, technical competence, and professional development.

We will have seven composite groups, 33 working groups, and two distributed working groups. In addition, there will be a plenary session, several special sessions, tutorials, demonstrations, posters, continuing education unit (CEU) granting courses, and the INFORMS Certified Analytics Professional (CAP) exam offered.

This year's program will include both classified and unclassified presentations, as well as presentations by analysts from our five eyes partner nations (Australia, Canada, New Zealand, and the United Kingdom). The virtual session will host only unclassified, publically releasable briefings. The symposium week begins on Monday, June 22, with the Rist prize competition, tutorials, and CEU courses. Vice Admiral James D. Syring, USN, Director, Missile Defense Agency, will be the plenary session keynote speaker on Tuesday morning, June 23. You may read his biography at www.mda.mil or in the December 2014 edition of *Phalanx*. The sponsor's panel, an informative and popular session, will immediately follow the plenary keynote address. The concurrent sessions for the composite groups, working groups, and distributed working groups begin after lunch and continue through Thursday afternoon.

The CEU courses will include at least three exceptional offerings. The first, "Introduction to Analysis for Practitioners," is designed for new analysts and provides a fundamental understanding of the performance of analysis in military studies through a series of lessons taught by seasoned senior analysts who have vast experience in conducting military and civilian studies. The second course, "Introduction to Analysis for Study Leaders," is designed for new study leaders or soon-to-be designated program managers. It will address the skillsets and project planning information essential for leading

technical studies that address effectiveness and cost analyses. The third course, "Introduction to Wargames and Technology," is designed for those with a desire to learn about wargaming as an operations research tool for analysis with an additional slant on technology. The goal is to provide a fundamental understanding of how wargaming as another form of simulation supports analytical studies.

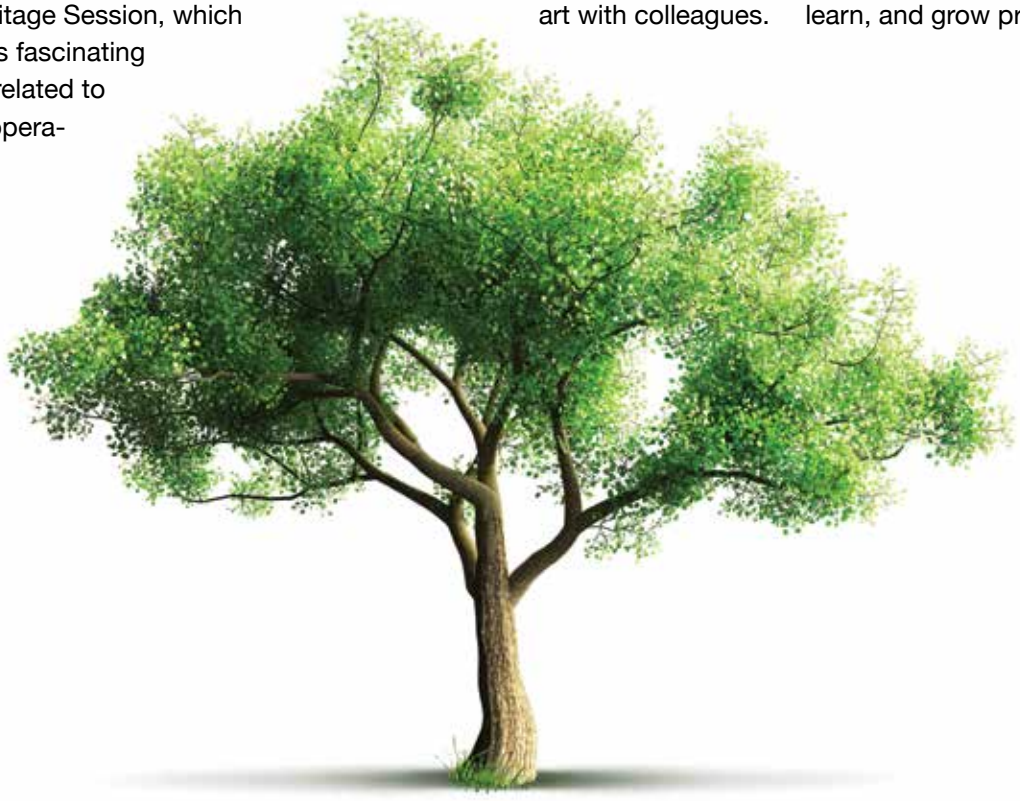
The special sessions promise to be very interesting, and will for the first time include the best paper presentation from the Australian Defence Operations Research Symposium (DORS), the best paper presentation from the US Naval Academy mathematics department, and an education panel discussion. Throughout the remainder of the symposium, special session topics will include the MORS Rist and Barchi prize winners, the Strategist's Corner, the Deployed Analyst Session, featuring analysts from across the Department of Defense discussing their recent deployment experiences, and the MORS Heritage Session, which always features fascinating presentations related to the history of operations research in the US military. Additionally, there will be presentations about MORS workshops completed during the months leading up to the symposium, a Junior-Senior Analyst Session, and MORS sponsor sessions on special topics of particular interest to the sponsors. The US Naval Academy and Australian DORS best paper presentations join the standing presentations by the service academy winners of the Hollis and Capstone Awards. Other special sessions include presentations from the Office of the Director of Naval Intelligence and from the MORS Communities of Practice. The Education Panel Discussion will include discussions from a collection of universities.

The 83rd MORS Symposium also features a full program of posters and demonstrations. Participants will have an opportunity to have hands-on experience with analytic tools, as well as examine a wide array of projects and discuss techniques of interest or advances in the state of the art with colleagues.

While at the 83rd MORS Symposium, don't overlook the well-attended networking event on Tuesday evening at the Hilton Alexandria Mark Center. It is a guaranteed, excellent way to make new friends and renew old friendships within our national security analyst community. We are working with the MORS office to examine the possibility of scheduling another networking event on Wednesday evening. Scheduling of the event will be dependent on cost and participation. Check the MORS website (www.mors.org) for updates on this potential event.

Make plans to now to join us at the 83rd MORS Symposium. Register early or use the "Invoice Me" option under the payment method during checkout to secure the early registration rate by April 1, 2015.

We've heard our senior leaders say that we must stay ahead of change, think globally, and be innovative. Do not miss this tremendous opportunity to showcase your work, collaborate, learn, and grow professionally.



2014-2015 MORS Wargame CoP Brown Bag Lecture Series

The Wargaming CoP holds regular "Brown Bag" lectures at the CAPE Offices in Mark Center, Arlington. The lectures are also "broadcast" via telephone conference and are focused on the following themes:

- Tools for the definition, design, execution, and analysis of analytic, training, education games
- Methods from other disciplines that may be of use in wargaming
- Other topics of interest to the group at large: results of past games, the theoretical, practical, policy, and legal issues concerning wargaming

Speaker	Date	Topic
Elizabeth Bartels	February 18, 2015	Better Game Design through (Deductive) Social Science
Guy Halftech	March 25, 2015	How to Use Games to Discover Your Cognitive Potential
Mike Garrambone	May 21, 2015	Tutorial and Practicum—Drive on Metz Wargame at the 83rd MORSS

Additional lectures are being planned. Suggestions welcome!

To be included among the wargaming "Brown Baggers," contact Mike Ottenberg at michael.a.ottenberg.ctr@mail.mil

MORS is exploring the possibility of establishing a Risk Assessment and Analysis Community of Practice. COPs typically meet every 1-2 months for about an hour with agendas varying from briefings on important new concepts to debates on controversial issues. Most members attend via phone. Please contact the MORS office at MORSOFFICE@mors.org if you are interested in being part of this COP.

INDUSTRY

On December 11th, a group of MORSians and government leaders in the national security analysis community gathered at the Hyatt Regency in Crystal City to discuss the needs of our workforce in the immediate future. It was a open exchange between the private sector providing analysis to government customers.

SHOWCASE

MORS Junior Analyst Program: A Personal Insight

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When I was first introduced to MORS, I thought of myself as the quintessential junior analyst. I was so new to operations research that I didn't fully understand its scope. I attended my first MORS in 2002 and gave my first MORSS presentation in the wargaming working group to a group of people I didn't know. I sat—alone—through other wargaming presentations. I was lost and didn't understand the working group structure nor did I fathom the immense value that belonging to MORS would come to provide to me.

Fast forward to December 2009. I no longer qualified as a junior analyst. Operations research had become less of an enigma. I found myself serving on the MORS Board of Directors with interests in promoting MORS to the outside world and seeking to identify the many benefits that the society provides to its members.

Within a year, MORS offered a special four-hour workshop—specifically for analysts fresh out of school or new to the discipline with less than 10 years of experience in operations research—designed to expose MORS to these fresh analytical minds and to find out what they wanted to contribute to a professional organization. That workshop began the investigation into the needs of newly identified operations research analysts. The 2010 annual membership survey included several questions directed to analysts who had been in the field less than 10 years and those under the age of 40. Respondents to that survey indicated that the junior analyst was interested in discounts (duh—who isn't!), networking opportunities, and mentorship. Additionally, they thought a junior analyst spotlight feature in the *Phalanx* newsletter (now magazine) would be good. Written comments were quite specific:

- "Providing opportunities for younger analysts to hear from senior analysts about ways to develop professionally."
- "Providing mentorship opportunities, even if only a list of names of older national security analysts willing to talk to younger national security analysts."
- "Perhaps a panel at a MORS conference with more senior analysts offering insights."
- "Exposing them [junior analysts] to the full variety of national security analysis that occurs and where it occurs."
- "Providing resources for the young analysts who are not serving in large analysis shops."

MORS responded to these requests with several opportunities that included a junior/senior analyst panel at the symposium; the formal launch of the "Young Analyst Initiative"; the MORS Mentorship Program gained more visibility; and junior analysts profiles began appearing in the *Phalanx*.

In the column "The Last Word," editor John Willis described these junior analysts, "The Ne(x)t Generation," as "being born after 1991, members of Gen Z would rather text than talk … they can't imagine a world without cellphones. They have never known a world without Internet or terrorism." (Willis, 2011, 36). In 2011, the 79th MORS Symposium's theme was "Developing the Next Generation of National Security Analysts." Mr. Norm Reitter and Ms. Angela Severe worked on shaping a junior analyst focus in the MORS membership. In December 2013, the MORS BoD voted to formally recognize the junior analyst sector of the society and just recently, the definitions and processes that shape the MORS Junior Analyst Program were accepted into the MORS Operations Manual (MoM). It is all official now!

The Junior Analyst program is run by and for junior analyst members under the MORS Membership Committee. Ms. Angela Severe, an analyst with Lockheed Martin, serves as the Junior Analyst program lead with support from the MORS Membership Committee, led by Dr. Simon Goerger. The two primary tasks are outreach and involvement. Outreach activities include the Junior Analyst profile

in the *Phalanx*, a junior analyst panel feature at the Education and Professional Development Colloquium held in the spring, and the Mentorship Program, led by Mr. Dennis Baer, FS. Involvement activities are wrapped into the Junior Analyst Ambassador (JAA) Program. The JAA places MORS junior analysts in direct contact with MORS Board Committees and leaders in the OR field. This experience with the MORS Board of Directors provides two unique skill-building opportunities for junior analysts. First, the ambassadors learn about how MORS works and they support the planning and execution of MORS events. Second, they advise MORS from the perspective of the up-and-coming analytical community. For example, the new generation of soldiers, "have grown up enmeshed in social media, have higher expectations about access to information, and young soldiers expect the military to be at the frontier of this communication revolution." (Szablowski et al., 2012, 27) As a professional organization dedicated to the military and national security, MORS looks to the junior analysts to provide guidance as the society embraces social media.

Opportunities abound for junior analysts, and these opportunities are as valuable for senior analysts as mentors and teachers as they are for the new analysts. The MORS website (www.mors.org) has details about publishing, networking, learning, mentorships, the JAA program, and much more.

Now, as a seasoned MORSian, I find analysts new to OR and encourage them to enrich their professional lives through MORS. I have looked at a list of (more than 50) new analysts who have been recognized by MORS and MAS over the past five years in the *Phalanx*. I recognize the names as active MORS members, and I see their professional growth.

For more information about the Junior Analyst Program, contact the MORS office and they will have Angela Severe or another JAA contact you directly.

References

Szablowski, E., Coronges, K., and Arney, C. 2012. Generation 2.0: Social Media and the Future of the Army, *Phalanx*, Vol 45, No. 1, 27–29.

Willis, J. 2011. The Ne(x)t Generation, *Phalanx*, Vol 44, No 2, p. 36.

DoD's Role in Network Science: NetSci Symposia on Models, Teamwork, and Education

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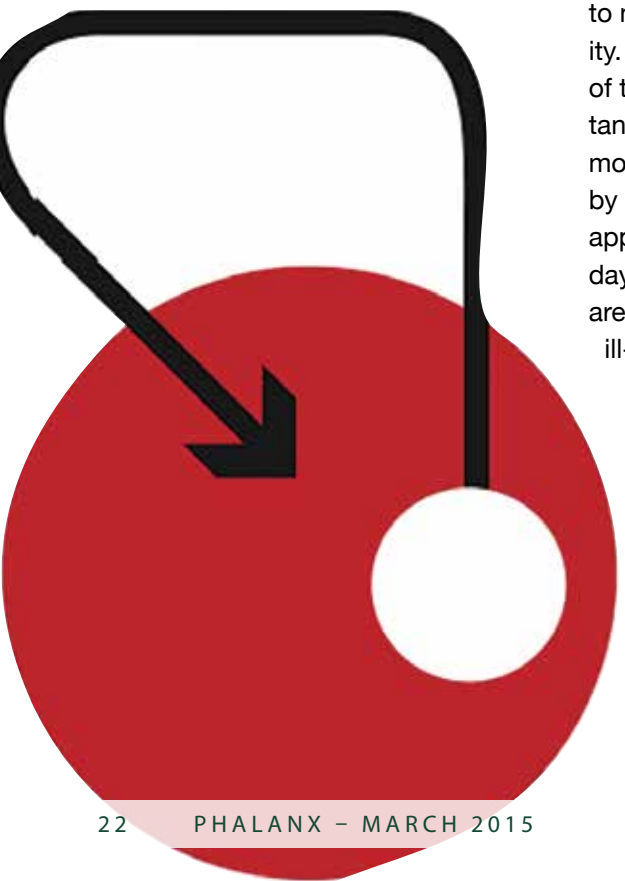
NetSci is one of the largest network science research conferences in the world and, like many network science events, researchers associated with the US Department of Defense (DoD) played a significant role in NetSci 2014. We report on three symposia held before the main conference that connected operations research and DoD applications of network science. As we describe the content of the symposia, we highlight the connections between military applications, operations research (OR), and network science (NS).

Background

The National Research Council (2005) defines Network Science (NS) as "the study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena." As stated by Eric Lang at NetSci, "DoD should care about [NS] because we spend trillions of dollars and have millions of people whose well-being we put on the line. We had better understand [NS] systems." Network modeling has enabled better awareness, analysis, and understanding for decision makers across every aspect of military operations, including communications, logistics, intelligence, training, planning, and operations. Analysts use networks to model the DoD's operational environment to provide intuition into how systems work and which elements are the most important to network functionality. Unfortunately, many of today's most important DoD networks defy modeling and analysis by traditional statistics or applied mathematics. Today's complex networks are too big, possess ill-defined organizational rules, change too much (and too fast), and manifest emergent and even chaotic properties. Into that breach steps NS.



Network science integrates multiple disciplines to understand, model, and analyze applications represented by complex dynamical networks, much like OR has taken multidisciplinary and interdisciplinary approaches to combine quantitative and qualitative methods and techniques to solve management problems. There is overlap of NS with OR. An OR analyst can describe NS in familiar terms: applied dynamic graph theory with additional attribute data, modeled as a dynamic, structured, entity-linked, interdisciplinary framework. The strength

of network modeling is its ability to embrace the complexity resident in reality, making NS an empowering form of nonreductive modeling and OR problem solving (Alderson, 2008; Arney et al., 2014).

The fields of NS and OR have intertwined futures. OR is an established field and profession; NS is embryonic. To realize its potential as a contributing field, NS is reliant on its partnering with OR to establish relevance in the modern information-centric world. To grow in capability, OR is becoming reliant on NS tools for analysis of the complex structures, synergistic processes, emergent behavior, and overwhelming data that characterizes real problems. Like OR, NS merges the social, informational, communication, and physical layers of systems analysis. These multilayered networks enable a comprehensive model with multiple dimensions, tremendous volumes of data, high complexity, diversity, and specialization within the organization or system.

Complex networks are ubiquitous in the military and lie at the core of DoD systems and models including communication flow, command and control, organizational management, and information assurance implementation. Most importantly, NS helps make sense of big data structures to build the underlying knowledge base for situational awareness. The DoD has recognized the import of NS, resulting in the development of network warfare commands and research centers in each of its agencies. For example, the DoD launched a major doctrinal shift in the late 1990s based on NS called net-centric warfare (Alberts et al., 1999). As Roehner (2007) reflected, "the real challenge is to do real physics and real sociology in the framework of network theory." The three symposia from NetSci 2014 contributed to DoD's efforts to answer Roehner's challenge.

NetSci Symposium on Network Science for National Defense

Network science and other emerging data science methods are showing promise for improving understanding and analysis in US national security and intelligence missions. However, the benefit from these new analytic methods remains only in small pockets of the DoD enterprise, not spreading in a systematic way to other network-relevant mission areas in the DoD. NS needs a boost in its awareness to reach its potential to solve problems that are currently out of reach or consideration to the DoD. The exchange of ideas in this symposium was intended to be a first step in broadly exposing the DoD to the promise of NS meeting the DoD's needs, and the DoD to NS field. Symposium organizers Mark Breckenridge (OSD) and Ralucca Gera opened the discussion with a panel of network science professionals led by Jon Alt responding to general questions with an insightful view of what NS is, who does it, and what it can (and can't) do for an organization. The panel touched on several import topics:

- *Problems areas suited for NS.* Modeling is at the heart of determining which problems are suited for NS approaches. Some techniques and problems are more appropriate than others. Ideal cases for NS involve relationship data that can be described by a network. Analysts build network models not only because they are descriptive, but also explanatory—providing insight into why things are the way they are.
- *Limitations of network science.* The panel identified two significant obstacles: understanding the nature of relationships and data availability and quality. Although NS is not purely a data-driven endeavor, data are important. Because networks are characterized by interdependencies, appropriate and accurate data must be collected and processed, preserving quality in the model while reducing the noise and error.
- *Profiling a network scientist.* The panel developed a profile of skills a DoD network scientist might possess. Further discussion concluded that organizations shouldn't look for just one hypertalented scientist; rather, form NS/OR teams with certain qualities

and capabilities. Such a team must be well rounded, possessing skills in several quantitative fields and exposure to the human dimension of the application.

Several speakers followed the panel discussion, sharing network and data science practices. Summaries of two of these presentations follow.

- *A Large-Graph Comparison Measure for the Topology of the Internet* (presented by Ralucca Gera). Graph theory is a direct predecessor to complex networks. It was one of the first scientific fields to describe and explore connectedness and relationships between entities. As DoD analysts' needs transition from simple, static, and relatively small graphs to complex, dynamic, and large ones, there is a transition in thinking needed from graph theory to NS. This presentation extended traditional graph-theoretic concepts to analogous ideas in NS. For example, Figure 1 illustrates the idea of graph comparison. In graph theory, we ask if two graphs or subgraphs are the same, or isomorphic. In complex networks, we measure the level of similarity between two networks.

- *Network Science for Military Applications: Practices, Pitfalls, and Potentials* (presented by Dave Alderson). This presentation summarized prevalent pitfalls in the application of NS to system design and opportunities for NS contribution in DoD applications such as social media and other large, unstructured datasets.

Other speakers included Pete Schirmer and Douglas Yeung (RAND), Ray Zimmerman (PERSEREC), Paul Lester (RFT), and Santiago Gil (Center for Complex Networks Research at Northeastern University). The symposium concluded with a working session during which participants divided into groups to discuss relevant DoD questions. You can find a link to a summary by Jon Roginski (NPS) of the working group discussion and the symposium's proceedings on the Network Science for National Defense Symposium webpage at http://faculty.nps.edu/rgera/conferences/NetSci2014/dist/. This symposium increased awareness of the potential for NS techniques to impact more areas of DoD operations. The symposium plans to convene again yearly to discuss additional DoD-relevant topics, further spread NS and OR awareness and compatibility, and chart the way forward for greater analytical support to national defense.

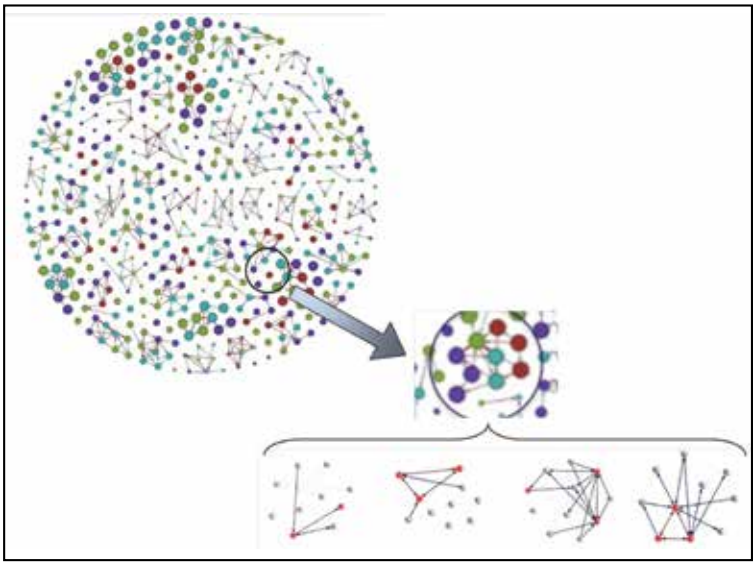


Figure 1. Graph theoretic vs. complex network measures.

NetSci Symposium on Team Networks

Examples abound in which teams perform better than groups of individuals—even when the individuals are more skilled than single members of the team. Researchers and practitioners speculate that the success of teams stems in part from their multidisciplinarity and their ability to assimilate, reinforce, and recombine knowledge and talent (Uzzi et al., 2013). The enhanced capacity of team performance over individual suggests there is potential for moving the boundaries of human achievement forward through more and better use of teamwork in networked organizations. Yet, knowledge about what factors are the primary drivers of success or how these drivers operate remains nascent. The NetSci Symposium on Teams sought to develop a framework for creating formalized theory, improved metrics, and viable models of team dynamics. Discussed at the symposium were recent developments in team-related cognitive science (team cognition), industrial and organizational psychology (science of team science), computer science and statistics (science of success), and management. The symposium's conclusion was that this topic is ripe for exploration as an integral part of DoD organizational and doctrinal development. Team networks enable groups of people to build knowledge, reach consensus, achieve breakthroughs, and generally perform complex problem solving that would not be attainable through either individual efforts or a sequence of additive contributions. A critical question in the military is how to improve the performance of teams and of multiteam systems (teams that work together to carry out missions).

Symposium organizers Kate Coronges and Chris Arney brought together several academic communities—network scientists, team and communication

scientists, cooperative systems scientists, and game theorists, many with DoD connections. Noshir Contactor (Northwestern) and Alice Leung (Raytheon BBN) presented frameworks to conduct social experiments in multi-team systems. Experimental data on communication activity reveals motifs or patterns of activity (shown in Figure 2) that can be used as explanatory variables to model team processes (dynamics) and outcomes (e.g., performance). Elisha Peterson (Applied Physics Lab) presented a group-level game theoretic framework based on Shapley theory, which teases out the rationality of the individual versus the rationality of the group. Measures of a person's individual contribution to the group using various subset boundaries can assess altruism and competition within team members. Darryl Ahner (Air Force Institute of Technology) presented a model of information need and sharing based on Miller, Miller, and Shattuck (2007) situated cognition model. Leslie DeChurch (Georgia Tech) gave the plenary talk on "Leadership and Networks." Two panel sessions predicting the future of team collaboration processes models, one from a mathematical modeling perspective and the second based in the social and behavioral sciences, concluded the workshop.

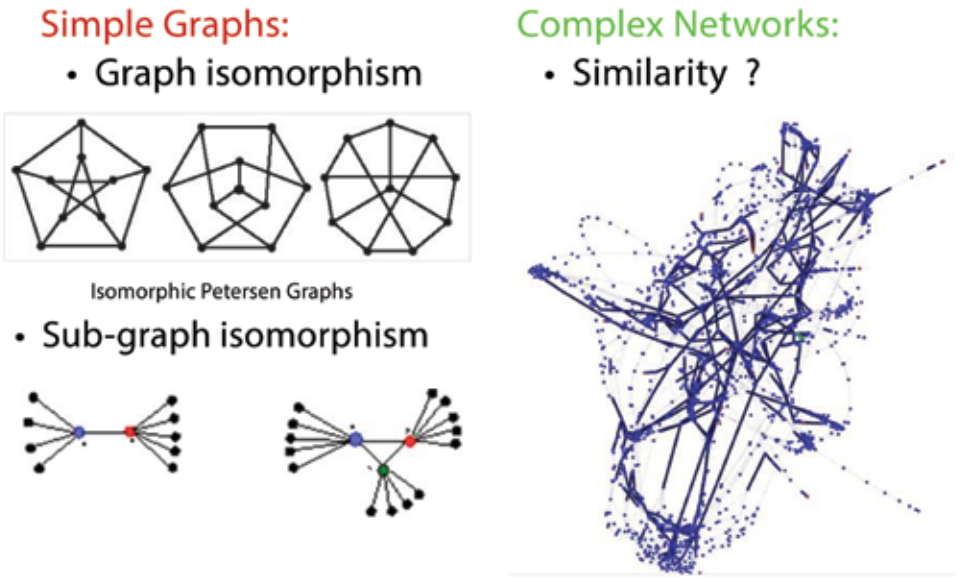


Figure 2. Motifs or patterns of activity are identified during field experiments or computer games and used to predict team dynamics and performance outcomes. This figure demonstrates motifs as presented by Leslie DeChurch at the conference.

NetSci Symposium on Education

Due to the complexity of today's operational environment, it is essential that future leaders, including military, are able to naturally leverage the connectivity of disciplines rather than reducing problems into pieces or groupings that are addressed individually with traditional "stove piped" disciplinary expertise. In anticipation of preparing the next generation to operate effectively in the complex, networked environment, a group of educators have been harnessing students' inherent interest in networks to engage them in interdisciplinary problem solving.

The NetSciEd Symposium, organized by Catherine Cramer and Stephen Uzzo of New York Hall of Science, Hiroki Sayama from Binghamton University, and Gene Stanley and Paul Trunfio from Boston University, and Lori Sheetz, focused on NS teaching and learning at all levels of formal and informal education. Topics discussed were:

- Teaching teachers network science concepts
- Network science in K-16 practice and policy
- Network science in the military
- Network science in informal education
- Tools for teaching network science
- New directions in learning science
- Developing metrics for effective educational collaboration networks
- Applying network science concepts to the Common Core framework.

Speakers included Mason Porter (University of Oxford), Toshihiro Tanizawa (Kochi National College of Technology, Japan), Brooke Foucault Welles (Northeastern University), and Robin Wilkins (UNC Greensboro).

Components of networks have been used as a tool for teaching math, computer science, and technology for many years. More recently, network scientists have expanded these efforts by developing and sharing informal outreach materials to demonstrate how NS can successfully be used to engage students in STEM fields (Harrington et al., 2013; Sanchez and Brandle, 2014) and to learn problem-solving skills. These successes led to a model in which NS is used to teach abstract concepts within formal education settings including the Common Core Learning Standards. Lori Sheetz presented her model for bringing NS into high school STEM curricula. Her educational framework was developed from working with teachers and school administrators by

shifting NS from an informal science research tool to a blended formal/informal educational topic.

Conclusion

Network science is poised to play an important role in the future of DoD critical operational and organizational applications (e.g., net warfare, wireless technology, intelligence processing). In recent years, DoD researchers have become a major force in developing the field to improve our understanding of the human domain. At NetSci, we were excited to see many applications of NS in the military and evidence of its ties and relationships to OR with an emphasis on situational awareness, learning and teaching strategies, and organizational dynamics. DoD has played a significant role supporting NS research and, based on what we heard at these three symposia, NS will continue to play significant roles in the future of DoD.

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Lori Sheetz does outreach and education research at the Network Science Center at West Point. For the past four years she has used her science and education background to bring the new field of network science to middle and high school students from around the United States through STEM workshops and yearlong research projects. She enjoys engaging students in STEM topics using the framework of networks, technology tools, and drawing on student insights gained through the prevalent adolescent use of social networks.

MOR Journal
Editor Search

The *Military Operations Research Journal* (*MORJ*) is a refereed journal sponsored by the Military Operations Research Society (MORS) and the Military Applications Society (MAS) of INFORMS (Institute for Operations Research and Management Science). *MORJ* publishes articles that describe operations research (OR) methodologies used in important military applications. *MORJ* also publishes papers that present case studies showing innovative OR applications, applications of OR to major policy issues, introduces interesting new problem areas, highlights educational issues, and documents the history of military OR. The *MORJ* serves many communities (academic, industry and government), and is both academically strong and technically sound. Historically, the journal has received about 40 articles per year, and about 50% of the articles are accepted after review and editing. Once accepted, an article usually requires one or more revisions to adequately respond to the technical and editorial issues raised in the review process.

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  - contact information
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Analytic Wargaming on the Rise

Jeff Appleget, Naval Postgraduate School, jaappleg@nps.edu; and Fred Cameron, formerly Centre for Operational Research and Analysis (Canada), frederickwpcameron@gmail.com

"A reinvigorated wargaming effort will develop and test alternative ways of achieving our strategic objectives and help us think more clearly about the future security environment."

—SecDef Defense Innovation Initiative memo, November 15, 2014

"The first and most important thing is our people. The second thing is what we want to do to reinvigorate wargaming."

—Deputy Defense Secretary Bob Work, on the Defense Innovation Initiative, Defense News interview, November 24, 2014

From its inception, military operations research has been inexorably linked to wargaming; the relationship is symbiotic and has benefited practitioners in both disciplines. Indeed, the overlap in a Venn diagram of the disciplines of military OR and wargaming is so large it is hard to find examples where wargaming will not benefit from OR, and where military OR will not benefit from wargaming.

Analytic wargames are designed to collect and analyze information from wargame play, and these results either feed directly into a decision, or are used to develop other analytic products. Outputs of analytic wargames such as concepts of operation (CONOPS), courses of action (COAs), and operations plans (OPLANs) are commonly used to "feed" other analytic activities or serve as the operational foundation for computer-based combat simulation analysis.[a]

Analytic wargames are particularly useful in scenarios where uncertainty is high. Instead of simply "red" and "blue," there may be many players, all with unique objectives. This includes operations where major cultural differences make understanding potential actions and reactions to unfolding events tremendously difficult or operations against new, unfamiliar threats in new regions, and operations that current doctrine doesn't adequately address.

Wargaming and History

Analytic wargaming has had a long and colorful history of success. The US Naval War College (NWC) began wargaming Plan Orange, operations against the Japanese in 1919, and created a rich body of analytic wargaming results

divided into three distinctly different phases (Vlahos, 1986):

- 1919–1927: The US Navy sails off to single-handedly destroy the Imperial Japanese Navy and relieve the Philippines just weeks after a declaration of war.
- 1928–1934: The US Navy realizes such a war may last longer and will require a phased approach necessitating large-scale amphibious operations with significant US ground forces.
- 1935–1941: The US Navy realizes that, in addition to the US Army and US Marine Corps, US forces will need help from regional partners.

The knowledge garnered in more than two decades of NWC wargaming Plan Orange led Fleet Admiral Chester Nimitz to famously say, "The war with Japan had been enacted in the game rooms at the War College by so many people and in so many different ways that nothing that happened during the war was a surprise—absolutely nothing except the kamikaze tactics toward the end of the war. We had not visualized these."[b] An even more telling tribute to Plan Orange wargaming came early in 1942 when Nimitz sent two young lieutenant commanders back to the Naval War College in Newport to gather previous wargaming results. Because NWC had changed Japanese strengths and weaknesses in each year's student-led wargame, Nimitz knew that NWC had wargaming results from one of its annual wargames that resembled the actual Japanese status that naval intelligence was reporting to him (Caffrey, 2000).

A more recent analytic wargaming success was the Desert Crossing wargame conducted in 1999 when Marine General Anthony Zinni commanded the US Central Command. He tasked his staff with conducting wargames to assess what could happen if regime change occurred in Iraq, deposing Saddam Hussein. The results were an eerie prediction of the post-"Shock and Awe" sectarian violence and regional power struggles that did in fact occur after the end of major combat operations in Iraq in 2004 (US Central Command, 1999). The wargame would have been tremendously successful had the National Command Authority given the game's results any credence as they planned for Operation Iraqi Freedom.

Computer-Based Combat Simulations Sideline Analytic Wargaming

Toward the latter part of the 20th century, the use of computerized combat simulations combined with other factors to relegate wargaming to a little-used tool for analysis. The dominant scenario that the United States DoD used to underpin acquisition decisions was the NATO-Warsaw Pact battle for Europe. This battle had been analyzed continually for decades and both sides' intelligence had been so well developed that, by the 1980s, nearly the entire world understood how the battle on the north German plain would unfold: attack corridors, force compositions, and equipment, even opposing commanders were all known. Tom Clancy's novel *Red Storm Rising* (Putnam, 1986) provided a realistic description of what that encounter would have looked like, and demonstrated the amount of information commonly available about that potential conflict. The dominant school of thought at the time seemed to be that there was no need to develop new courses of action or get fresh subject matter expertise on the battle to be fought; all that was left was the fight itself.

Computers started to impact military thought in the 1970s, changing the wargaming landscape forever. At first, computers were used to help with the bookkeeping of wargames, accounting for the physical phenomena such as adjudicating the outcome of engagements, tracking unit and vehicle movements, and accounting for logistics expenditures. The wargame Battle Analyzer and Tactical Trainer for Local Engagements (BATTLE) utilized a Wang 2200 computer to do what computers do best:

"The software was therefore designed to provide players complete freedom of action with respect to tactics employed and decisions made during the course of an exercise. Its function is to free players and controllers from the burden of complex, time-consuming computation, recording, and exercise management requirements and thereby permit the maximum possible involvement of exercise participants in the tactical decision-making process" (TRADOC, n.d.).

At some point, the allure of developing a computer-based combat simulation that was entirely automated and could replicate a major campaign was realized, and "closed-loop" combat simulations started to become a staple of operations research. Several of the major combatant commands adopted the Joint Staff's combat simulation Tactical Warfare Model (TACWAR) to assess courses of action and otherwise augment their planning processes.

These closed-loop computer-based combat simulations fall into two basic categories.

The first are theater- or strategic-level, lower-resolution combat simulations that represent forces in an aggregate manner, and often use some adaptation of heterogeneous Lanchester equations to adjudicate combat engagements (Taylor, 1983). Human

decision making in these simulations is rudimentary at best, such as, "attack when you have a 3:1 advantage," "defend when your opposition has a 3:1 advantage," and "skirmish when neither of the sides can muster a 3:1 or better force ratio." Many of these simulations are deterministic.

The second are tactical- or operational-level, higher-resolution combat simulations that represent each major system or entity on the battlefield. Movements are typically scripted from waypoint to waypoint and the human decision making modeled in these simulations is to basically fire or not fire when an enemy is detected. Many of these simulations are stochastic, and a single scenario is run multiple times and the average result is calculated and reported.

These closed-loop simulations generate plenty of numerical output that can be processed and plotted. Because there was considered to be little uncertainty of how a battle would be fought, it seemed to make perfect sense to place the burden of the analysis on these combat simulations. Thus, the focus of the decision making during the Cold War was on hardware and equipment performance while largely ignoring human decision making.

Analysts perhaps oversold senior leaders on the benefits of these closed-loop combat simulations, and many started referring to these simulations as computerized wargames, or just wargames. This obfuscated the fact that there was really very little human decision making represented in these simulations, and the decision making that was represented might not hold up well to close scrutiny. A somewhat famous paper demonstrated that a very simple homogeneous Lanchester model of combat produced chaotic and nonintuitive results and was largely ignored by the analytic community (Dewar et al., 1991). Instead, more complex combat simulations were developed, fielded, and used with increasing frequency. Many analysts of that era will recall the discussions and various constructs for the calculation of combat power that were used in our aggregate models, the basis for those "simple" 3:1 attack thresholds.

Resurrecting Analytic Wargaming

US Army analytic organizations realized that closed-loop combat simulations could not be relied upon as the single tool needed to do analysis. Although the automated decision rules allowed for the development of stochastic combat models that could be run numerous times to ensure there was a representative set of battle outcomes, the automation of the human decision making process in these simulations was recognized to be too simplistic to rely on for a complete assessment of combat operations. The US Army Training and Doctrine Command Analysis Center (TRAC) developed analysis protocols that first used wargames to thoroughly examine different COAs before deciding on a single course of action that was then scripted into closed-loop combat simulations.

TRAC-White Sands Missile Range has used the human-in-the-loop (HITL) computer-based wargame Janus to develop Concept of Operations (CONOPS) for brigade-level fights and to validate new system tactics, techniques, and procedures (TTPs) by bringing in warfighters from the various TRADOC schools to command the forces in Janus. Those CONOPS and TTPs captured from the Janus fight were then instantiated in

the closed-loop simulation Combined Arms and Support Task Force Evaluation Model (CASTFOREM), which provided a robust look at how well our forces performed with warfighter-developed maneuver. Similarly at TRAC-Fort Leavenworth, "orders drills" were conducted by warfighters to develop the division and corps-level CONOPS, which was then integrated into the Vector-in-Command (VIC) model. The Center for Naval Analyses used Marine Corps officers to develop its tactical decision rules when preparing the amphibious warfare model for the amphibious assault vehicle analysis of alternatives in the early 1990s (Akst, 1995). More recently, TRAC has leveraged "expert elicitation" techniques by interviewing serving or former brigade commanders to obtain their warfighting perspective on various brigade combat team (BCT) formations. The results of those interviews were used to integrate human decision making into analysis that underpinned the Army's recent brigade combat team transition to three-battalion BCTs (Salmeron and Appleget, 2014). Today the US Army Center for Army Analysis (CAA) wargaming capability provides the organization with a true end-to-end campaign analysis capability as they integrate COA developed through wargaming into their Joint Integrated Contingency Model (JICM) combat simulation.[c]

One of the significant by-products of recent engagements in Iraq and Afghanistan has been the experience analysts have gotten as they have been integrated into joint and multinational headquarters. The close partnership formed between analysts and planners provides a template for more relevant, comprehensive, and collaborative analytic products in the future. In particular, planners have never forgotten the usefulness of wargaming, and wargaming plays a prominent role in US and many of our allies' operational planning processes. The United Kingdom's Defence Science and Technology Laboratory (Dstl) created a computer-based wargame called the Peace Support Operations Model (PSOM), which was used in Afghanistan to wargame the International Security Assistance Force (ISAF) campaign plan in the spring of 2011.

CAA responded to commanders in Iraq and Afghanistan and created a wargaming capability that allowed them quick-turn analysis responding to the forward deployed analysts in Multi-National Force–Iraq (MNF-I) and ISAF. Today CAA is building a strong reputation for wargaming excellence recognized by COCOMs by supporting PACOM and USARPAC with wargaming expertise.

Conclusions

As the demand grows and more wargaming is sought, it is clear that the skills needed to design, develop, conduct, and analyze wargames are not well known, or if known, not well implemented. There are still many "wargames" being conducted that are little more than BOGGSATs (bunch of guys and gals sitting around a table), as evidenced by the lack of useful wargaming results from many of DoD's higher level wargaming events. Other organizations are trying to recreate our combat-simulation-heavy pre-9/11 wargaming capability by collecting and federating existing combat simulations for analysis. They seem unaware of the scenario and data challenges today's uncertain world presents.

COCOM planning organizations should partner more closely with analysts from their own headquarters and from other analytic organizations. Plans should be dusted off, reexamined, and updated, and then wargamed periodically, with planners and analysts teaming to produce rigorous, well documented and viable plans.

Peter Perla's *The Art of Wargaming* (US Naval Institute, 1990) is a great reference that sets the foundation for modern military wargaming, but the book is nearly a quarter of a century old. Since then, much has been learned about wargaming that needs to be collected, triaged, documented, and published. MORS began a presequester initiative led by Scott Simpkins of the Johns Hopkins Applied Physics Laboratory to capture what we've learned about wargaming that should be reinvigorated.

Finally, wargaming education needs to be embraced. Although US doctrine mandates that our planners wargame, details on how to conduct useful wargames are scarce in our doctrinal literature. Our war colleges and staff colleges need to devote more time to wargaming, to include having students build libraries of useful wargaming results of potential future conflicts, like NWC did with Plan Orange. All analysts, including civilian analysts, should take a course in wargaming. As part of the MORS initiative to provide professional development to OR practitioners, a component should be included that offers the skills necessary to design, develop, conduct, and analyze professional wargames.

Notes

[a] We have purposely included planning wargames under the heading of "analytic wargames" because planning wargames are wargames that are designed to produce output that feed into operational decisions.

[b] Remarks by Dr. Donald C. Winter, Secretary of Navy, Current Strategy Forum, Naval War College, Newport, Rhode Island, June 13, 2006.

[c] Personal communication with Dr. David Knudson, CAA.

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About the Authors

When Jeff Appleget joined the Naval Postgraduate School Operations Research Department in 2009 and was asked to update the Wargaming Applications course, he first read Peter Perla's book The Art of Wargaming and then called Fred Cameron (then an analyst with the Centre for Operational Research and Analysis (CORA) of the Canadian Department of National Defence) to see if he would help design a seminar wargaming week for the course. Five years later, they have fielded requests for wargaming support from PACOM, CENTCOM, AFRICOM, and others; mentored students developing wargames for DoD analytic organizations, COCOMs, and industry partners; co-authored and taught wargaming short courses for the Canadian Forces Aerospace Warfare Centre, STRATCOM, and Lockheed Martin; and integrated wargaming into peacekeeping and counterterrorism modeling courses delivered in Kazakhstan, Kyrgyzstan, and Tajikistan.

Practical VV&A for DIME/PMESII Models

Dean S. Hartley III, Hartley Consulting

The Department of Defense (DoD) requires that models and simulations (M&S) undergo verification, validation, and accreditation (VV&A). The Modeling & Simulation Coordination Office (M&SCO) provides voluminous resources concerning VV&A, including an excellent description of the basics (http://msco.mil/VVA_RPG.html). However, M&SCO must attempt to cover all possible uses of M&S by DoD. I am interested in DIME/PMESII models, which I define below. Further, the M&SCO resource is prescriptive, rather than descriptive. I have had more than 40 years of experience in practicing verification and validation (V&V), the last 10 of which have involved DIME/PMESII type M&S, and I am uncomfortable with some prescriptions. A point-for-point discussion of the differences would be tedious. Instead, I describe the lessons I have learned, with plenty of references at the end for further reading. These lessons are centered on simulation models. I address more specialized simulation concerns, such as human-in-the-loop models and agent-based models, elsewhere (Hartley, 2014).

Definitions

The DoD Instruction, DoDI 5000.61 (DoD, 1996) provides the basic definitions of VV&A :

Figure 1. Model Building Process

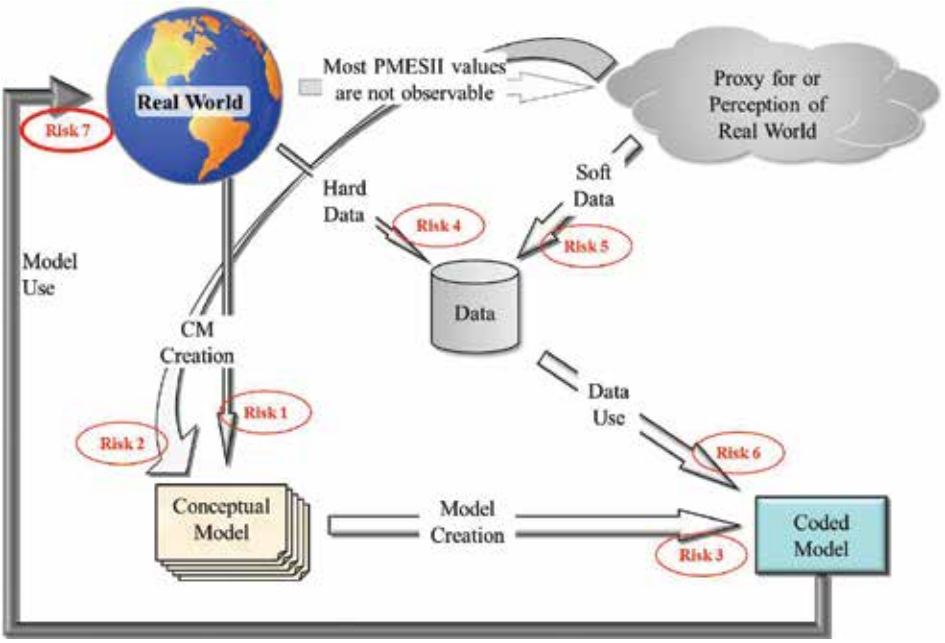
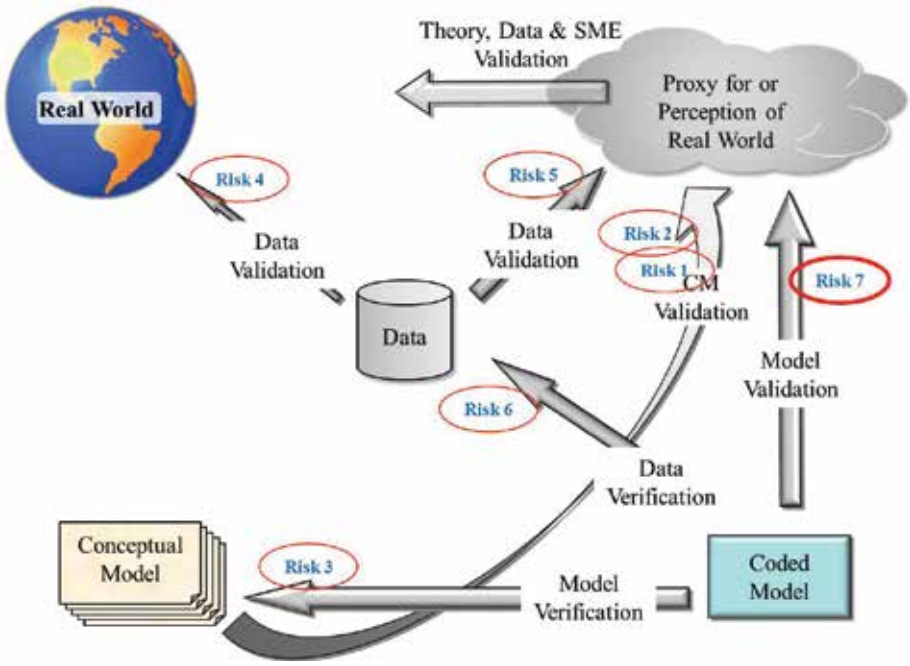


Figure 2. Model V&V process.



- *Verification* is the process of determining that a model or simulation implementation and its associated data accurately represent the developer's conceptual description and specifications.
- *Validation* is the process of determining the degree to which a model or simulation and its associated data are an accurate representation of the real world from the perspective of the intended uses of the model.
- *Accreditation* is the official certification that a model or simulation and its associated data are acceptable for use for a specific purpose.

The M&SCO description provides succinct paraphrases: "verification—did I build the thing right?"; "validation—did I build the right thing?"; and "accreditation—is it believable enough to be used?"

The DIME and PMESII acronyms represent an attempt to understand the complexities of what used to be called operations other than war (OOTW) and are now generally contained in irregular warfare (IW) operations. This effort is also known as human social culture behavior (HSCB) modeling. The acronyms can be defined as:

- Levers of power: DIME is a decomposition of what can be done about a situation: Diplomacy, Information, Military, Economic
- Metrics: PMESII is a decomposition of the state variables that describe the situation: Political, Military, Economic, Social, Information, Infrastructure

Some decompositions include additional elements, depending on the authors' views and experiences. I find it convenient at times to refer to DIME+ and PMESII+ as shorthand to indicate that the "official" acronyms can be modified. These decompositions are models of the underlying concepts. Refinements and further decompositions have yielded an IW ontology (Hartley and Lacy, 2011, 2013; see also http://home.comcast.net/~dshartley3/IWMetricOntology/IWTotalOntology.htm) that has proved useful to the US Army TRADOC Analysis Center (TRAC) and for VV&A of DIME/PMESII models (http://home.comcast.net/~dshartley3/VVATool/VVA.htm).

VV&A Process

The DoD has and continues to employ a very large number of models and simulations. This M&S collection includes several types with distinct properties with regard to VV&A. For example, models of missile flight permit nearly complete V&V because most of the variables have very strong physical-law bases (see Hartley et al., 1990) for an example of V&V for this type model). On the other hand, combat models and DIME/PMESII models must rely on human behavior models, which are inherently unreliable.

Throughout this article, I will be highlighting important lessons learned as the first, second, etc., thing to know about V&V. Underlying all of this is the zeroth thing to know: VV&A is not about proving a model right or wrong. It is a risk mitigation process involving understanding the model: Did I build the thing right? Is it believable enough to use? The risk is that the answers might be "no." Most of the time the answers are "sort of" and "I don't know." The risk mitigation involves discovering as much as possible about the model to figure out what can be done to improve the answers or to limit the use of the model to areas where the answers are as good as can be achieved.

To find out where the risks lie, it helps to understand the process of creating a model. Figure 1 illustrates the process. We start with the "real world," or at least that part that is relevant to the model we wish to build. Immediately, we realize that most DIME/PMESII (PMESII for short) values are not observable in the real world. We can get some things from the real world; however, we will mostly have to work from a proxy for it or a perception of the real world. These are the "referents" described in Appleget et al. (2011). We will create a conceptual model. (Note this diagram leaves out the cyclical nature of the real process for simplicity.) We find our first two risk points where we are abstracting concepts from the real world or the proxy to create the conceptual model.

From the conceptual model, we create a coded model with the attendant third risk point of incorrect conversion of the concept to the coded model. Before we can use the model, we will have to obtain the data to feed it. The fourth and fifth risk points arise from collecting the data. Did we get the correct values? Are they commensurate, etc.? The sixth risk point arises from converting the data for use by the model. Do the model's assumptions about the data fit the definitions of the actual data? The final risk point arises when we use the model. Are we interpreting the results correctly?

Figure 2 shows how the parts of V&V are structured to address these risks. Risks 1 and 2 are addressed by conceptual model (CM) validation and theory and SME validation from the proxy. Risk 3 is addressed by model verification. Risks 4 and 5 are addressed by data validation. Risk 6 is addressed by data verification. Risk 7 is addressed by model validation and theory, data and subject matter expert (SME) validation. Notice that the risks that rely on this last validation part have a problem: the arrow does not extend

Figure 3. System Structure

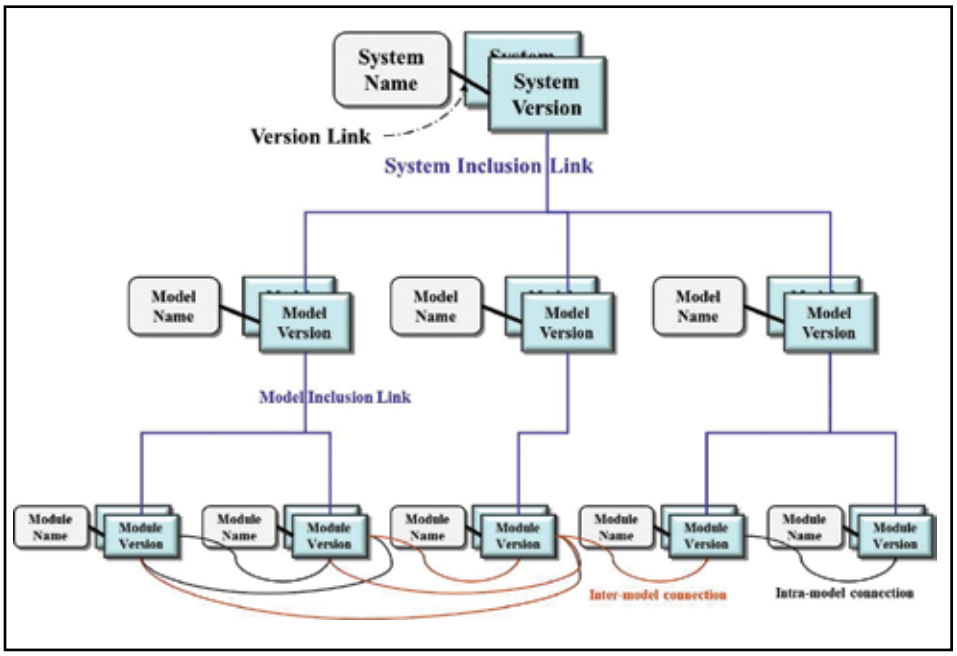
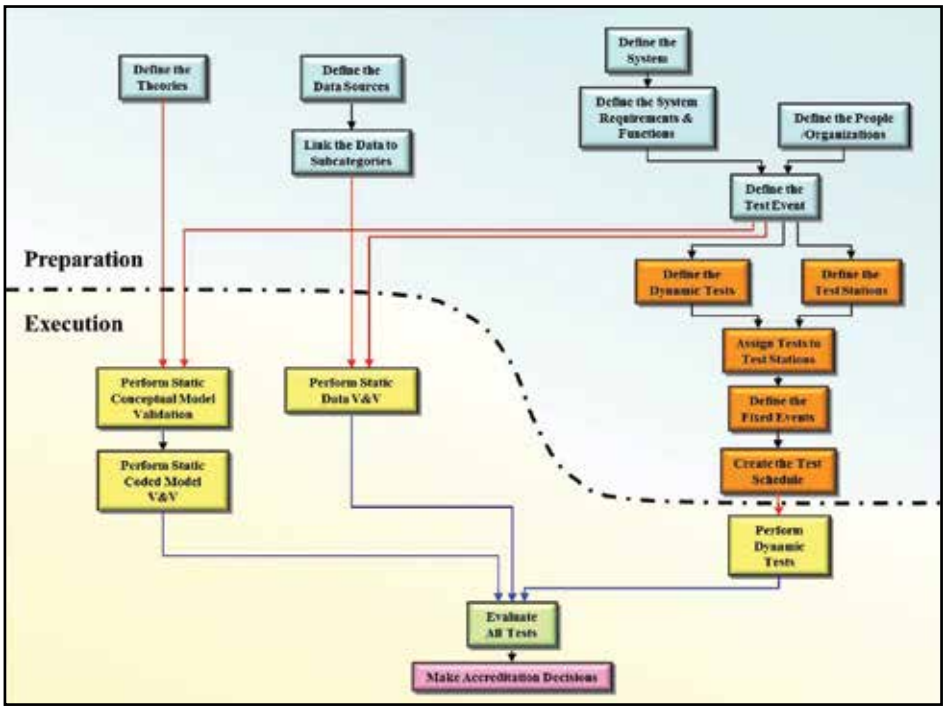


Figure 4. The W&A Process Flow



fully from the proxy to the real world. This indicates that for DIME/PMESII models, we don't know enough about the way the real world works to know whether what we did was right. In this figure, the risks are colored blue, rather than red, to indicate some mitigation; however, the ovals are still red to indicate that at any given point, we still have more to do.

Organizing to Perform VV&A Versions

The first thing to recognize is that you don't do VV&A on model "X." "X" is just a label. You do VV&A on a particular version. Depending on the changes from one version to another, the results from the VV&A work on the first version may carry over with no changes to the next version or may have almost no application to the next version. Figure 3 illustrates a generic system structure. A very simple model may have no subpieces; however, many large models are decomposed into a system/model/module structure, with each piece having its own version number. As the figure shows, the intramodel and intermodel connections are actually made at the module level.

Preparation

The second thing to know about VV&A is that proper preparation is one key to successful VV&A execution. Figure 4 illustrates this point with the process flow for using the DIME/PMESII VV&A tool. The four yellow "perform" boxes in the execution phase are preceded by 12 preparation boxes. Other VV&A flows may differ in their details; however, my experience has been that at least four weeks of preparation are necessary for each week of formal testing. In this case, the tool that supports the VV&A process is a database system that will produce extensive documentation. Accordingly, it requires careful definition of the items that will be used in the process and in the documentation. The preparation steps include:

- Theories with validity judgments will be linked to the ontology-defined parts of the model to justify the validity judgments.
- Data sources with validity judgments will be linked to the parts of the model for similar justifications.
- The system, based on versions, has to be clearly defined so that the output records will refer to the correct system version and so that subsequent VV&A processes can use prior results.
- The system requirements and functions, upon which the decisions about the system will be based, must be clearly defined.

Figure 5. Entrenched W&A Elements

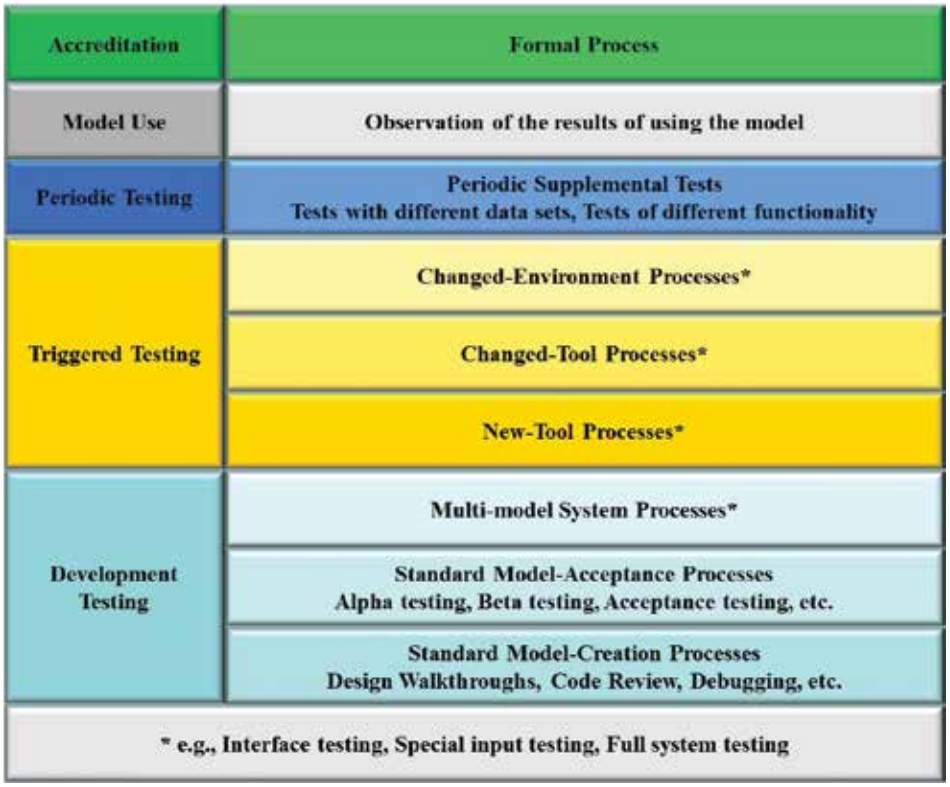
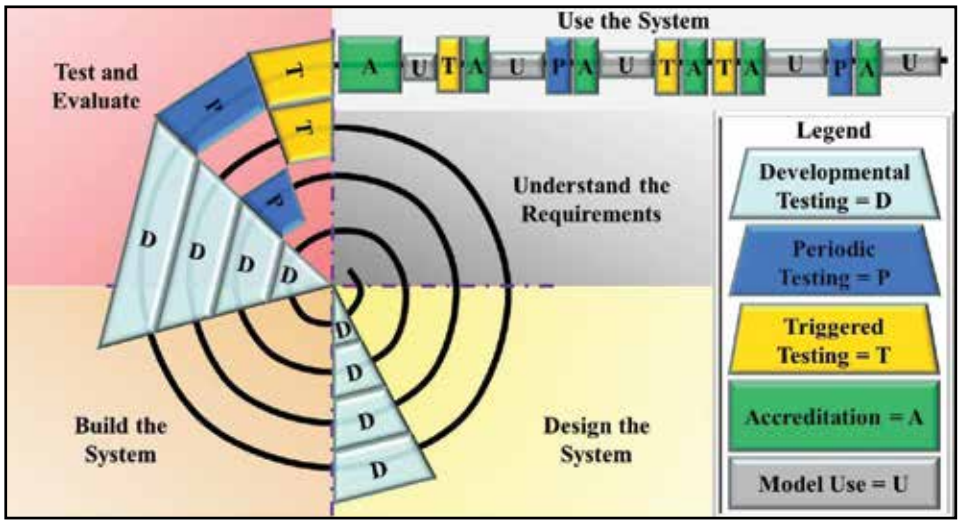


Figure 6. Applying Entrenched W&A



- The people and organizations involved in the process must be defined so that the record will clearly show who did what and who made which decisions.
- Each test event (more about this later) must be defined, from the tests that will be performed (with expected results) to the physical test station and the schedule of testing. This is needed to ensure that all of the tests can be carried out in the allotted time with the available equipment and facility layout.

The actual execution is relatively simple, subject to several observations.

First, some of the steps do not require model execution. These are labeled "static" tests:

- Conceptual model validation includes identifying the theories upon which the conceptual model is based (addressing risks 1 and 2).
- Coded model V&V includes judging the quality of the implementation of the theories (addressing risks 3 and 7).
- Data V&V includes identifying the data sources used by each module and judging the appropriateness of each data source for the module's modeling assumptions (addressing risks 4, 5, and 6).

Second, a major part of the V&V process requires model execution. The tests within this step are referred to as "dynamic" tests. These tests should have address the system requirements and functions (principally addressing risk 3).

Third, the test evaluation step is partially automated, with generated reports that present the results graphically and in lists, both at a highly detailed level for action by the system owner and at a higher level for executive view.

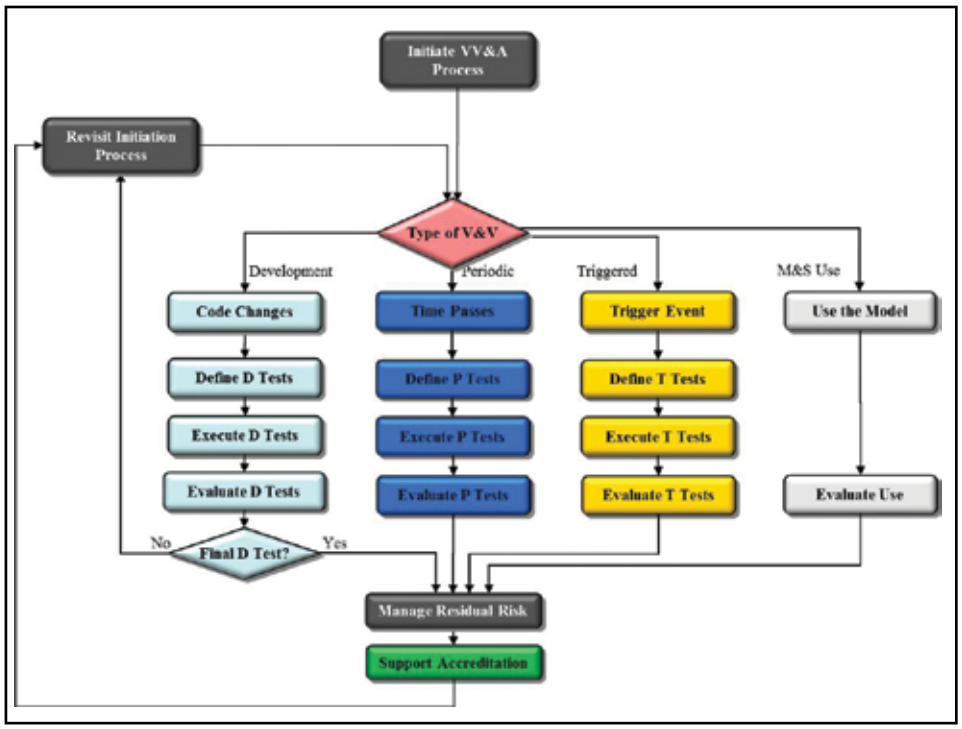
Finally, the system supports recording the accreditation decision, with caveats when necessary.

Entrenched VV&A

The third thing to know about VV&A is that it is not something that is to be tacked on upon completing the M&S creation work. VV&A is an entrenched process that is employed throughout the lifecycle of a model.

As shown in Figure 5, all of the development testing should be understood to be part of the VV&A process. This testing should be credited as V&V work. In addition, any time something changes, these changes should trigger additional testing, which is part of the process. A change to a module should cause version changes for the module, its containing model, and the

Figure 7. Simplified Entrenched W&A Process Flow



system as a whole—and this implies a need for triggered testing. Periodic testing presents the opportunity to build on what has been learned during previous V&V efforts. Each model use also presents the opportunity to build up knowledge about the model—again part of the VV&A process. Finally, accreditation is obviously part of the VV&A process. However, in the entrenched process, accreditation is not a one-time event, but one that occurs as needed.

Figure 6 illustrates the repetition of the entrenched VV&A elements during the course of a typical spiral development cycle and into the time of use of the model. Obviously, the triggered testing cannot be forecast ahead of time; so these events are added to suggest random occurrences.

Another way of looking at entrenched VV&A is shown in the flowchart in Figure 7.

This figure emphasizes the types of events that engender the entrenched elements. Code changes engender developmental tests; the passage of time spawns periodic tests; special events cause triggered tests; and using the model leads to additional evaluations. The discovery of problems leads to the need to manage the risks. Finally, the knowledge gained supports accreditation decisions.

Documentation

The fourth thing to recognize is that the VV&A process must be documented. Without adequate documentation, nothing is known about the model. There may be people who each know something about the model, its qualities, and it deficiencies; however, people move on to other projects, taking their knowledge with them. Even people who stay will forget some of the things they know.

Everything needs to be documented, including such mundane elements as people and organizations involved (with roles) and dates and places of testing. Naturally, the details of each test, with conditions, results, and mitigation plans, must be recorded. Further (remember the model-use "testing"), all significant events that occur during model use must be recorded, including successes. When performing triggered VV&A, tests must be divided between tests of new functionality and repeats of tests that were passed by the old version of the model. This requires knowing what tests were passed and their results.

The volume of data generated by testing any moderately large DIME/PMESII model is quite large. This means that the data must be organized for ease of retrieval so that it can be actually be used.

V&V Techniques

Most of the individual tests that can actually be performed on DIME/PMESII models are fairly simple. The problems that arise come from the sheer number of tests, the difficulty in analyzing and presenting the results, and using the data from previous testing. Numerous sources discuss V&V techniques (notably Knepell and Arangno, 1993; and Balci, 2001). It is useful to know about these techniques; however, less than a third of them are applicable to DIME/PMESII models, which simplifies the problem of picking techniques. Figure 8 is a version of the list from Balci (2001). The techniques that are readily applicable to most DIME/PMESII models appear in red text.

Practically speaking, there is never time enough to do all the testing that might be useful. This fact feeds back into the concept of entrenched VV&A, with thorough documentation to ensure that subsequent testing builds on previous testing.

The fifth thing to know about the VV&A process is that you will need a system to organize the process. This is the genesis of the DIME/PMESII

Figure 8. Standard Test Types

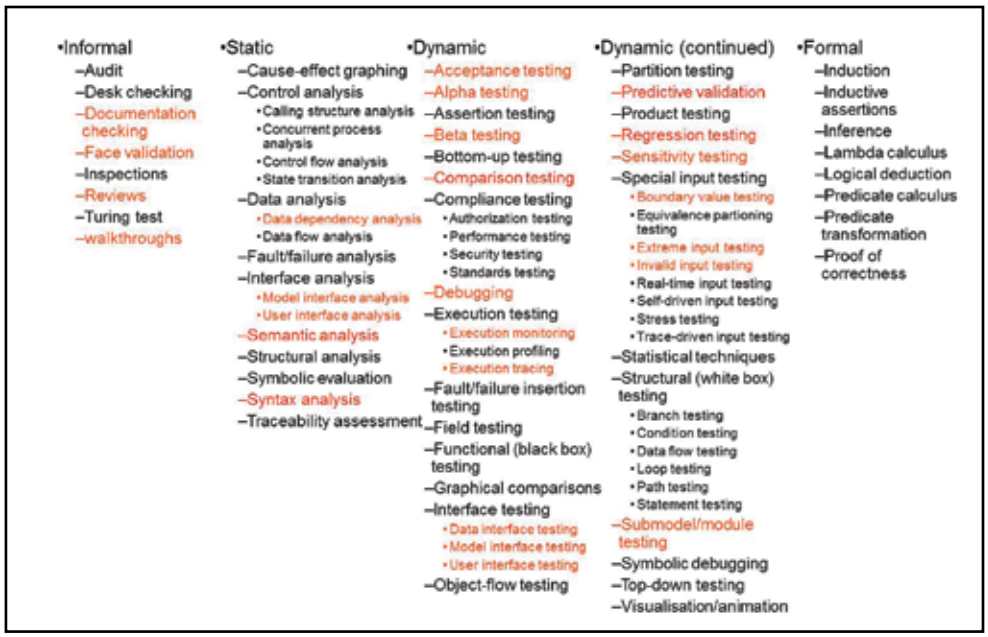


Figure 9. W&A Process Maturity Metric

Level	Validation Criteria	Referent	Conceptual Model	Development Products	Simulation Results	Documentation Consistency	Testing Standards	Configuration Management Standards
0	none derived	none chosen	none constructed	verified enough to support development	not validated at all	little or no documentation	no standard practices	no standard practices
1	represented by SME opinion	represented by SME opinion	none constructed	verified enough to support development	validated by SME observing simulation results	little or no documentation	no standard practices	no standard practices
2	defined from user statements as entities represented, their attributes & the dependencies among them	represented solely by SME opinion, based on intended use of the model/system	validated against the validation criteria by the SME	verified against the conceptual model inventory	validated by SME against the validation criteria	standard documentation produced, but limited in scope	standard practices with developer performing the V&V tests	standard configuration management, but not standardized
3	defined from user statements as Level 2 terms plus attribute ranges, domains & errors	derived from a single source, based on intended use of the model/system	validated by objective party from validation criteria & referent	verified against the conceptual model	validated by objective party from validation criteria & referent	standard documentation produced, with nearly complete scope	standard practices with someone other than the developer performing the V&V tests at acceptance or accreditation time	standardized manual configuration management
4	defined from user statements as Level 3 terms plus confidences	sampled from multiple independent sources, based on intended use of the model/system, & correlated statistically with estimates of uncertainties	validated by objective party from validation criteria & referent; analyzed to suggest results sampling space & estimate the confidence associated with the sampling	verified against the conceptual model; provides information to guide results sampling & estimate the confidence associated with that sampling	sampled from guidance developed from C&I & verification analyses; validated by objective party from validation criteria & referent	standard documentation produced, with complete scope and database	standard practices with a disinterested party performing the V&V tests at acceptance or accreditation time	standard computer based configuration management
5	Level 4 terms formally derived from user statements using causality arguments	rigorously derived from multiple independent sources, based on intended use of the model/system, & characterized statistically with estimates of uncertainties	formally stated & validated automatically from validation criteria & referent; analyzed to define results validation sample space	verified against conceptual model & used to define results validation sample space & the confidence associated with that sampling	automatically sampled from guidance developed from C&I & verification analyses; validated automatically from validation criteria & referent	standard documentation produced, with complete scope and database and complete retrieval system	standard practices with a disinterested party performing the V&V tests at acceptance or accreditation time	standard computer based configuration management with check-out, check-in safeguards

Probable Current Level

Probable Achievable Level

* Red font indicates additions to the Harmon & Youngblood VPMM

VV&A tool. It is one of the systems that can support this organizational need. The Navy supplies another tool (mentioned in DoN, 2004). When last checked, this Navy tool was Web-based; however, the model types covered were much more general than DIME/PMESII models, resulting in many input requirements that are not germane to DIME/PMESII models.

Maturity

Harmon and Youngblood introduced a Validation Process Maturity Model (VPMM) to measure the maturity of the validation process (Harmon and Youngblood, 2005). Figure 9 extends this model (indicated by the text in red). Note that documentation is one of the key areas for determining process maturity.

This figure also indicates the probable level of most current DIME/PMESII VV&A and the highest probable achievable level. Many DIME/PMESII models are at level 1 or 0 because they do not meet all the criteria for the next level. Given the difficulties associated with the social theories upon which DIME/PMESII models must be based, many of the level 4 criteria are simply not achievable.

The sixth thing to recognize about the DIME/PMESII VV&A process is that the results will not be as complete as the results for physics-based models. The science behind DIME/PMESII models is not mature.

Conclusions

VV&A for DIME/PMESII models is possible; however, the seven points discussed above relative to such VV&A must be reiterated:

- VV&A is not about proving a model right or wrong. It is a risk mitigation process involving understanding the model. The risk mitigation involves discovering as much as possible about the model to figure out what can be done to improve the model or to limit the use of the model to areas where the answers are as good as can be achieved.
- You don't do VV&A on model "X." You do VV&A on a version.
- Proper preparation is one key to successful VV&A execution. Experience says that at least four weeks of preparation are necessary for each week of formal testing
- VV&A is not something that is to be tacked on upon completing the M&S creation work. VV&A is an entrenched process that is employed throughout the lifecycle of a model.
- The VV&A process must be documented. Without adequate documentation, nothing is known about the model.

- You will need a system to organize the VV&A process. The problems that arise come from the sheer number of tests, the difficulty in analyzing and presenting the results, and using the data from previous testing.
- The results of the DIME/PMESII VV&A process will not be as complete as the results for physics-based models. The science behind DIME/PMESII models is not mature.

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The Challenge of Integrated Space Analysis

Jim Muccio, US Air Force

In March 2014, on the eve of his retirement from his position as the Navy (USN) Sponsor to the Military Operations Research Society (MORS) and the Director Assessment Division in N81, Mr. Arthur H. "Trip" Barber, wrote an article in the March 2014 *Phalanx* entitled, "Joint Warfare Analysis: The Key to Shaping DoD's Future." In this article he presents a stunning indictment of how the Office of the Secretary of Defense (OSD) and the Joint Staff (JS) have taken the DoD analytic community away from campaign-level analysis. Prior to 2012, OSD and the JS, working with the Services and Combatant Commanders (COCOMs), led efforts to produce baseline campaign analyses that enabled the services to assess their needs in the context of a joint environment where the contributions from other players were represented reasonably. OSD and the JS have taken us in reverse. Mr. Barber specifically referenced philosophical differences in the ability to achieve useful results given the complexity and uncertainty of analysis conducted at this level. To paraphrase, it's too hard.

We stand at the crossroads with the future of campaign-level analysis hanging in the balance. Looking into the future, the decisions that both the DoD and the Services will make become even more complex, with a level of uncertainty that is unparalleled in DoD history. This important work will only become harder. As we struggle to perform joint analysis with accurate representations of the effectiveness of our combat forces with enough accuracy to make force structure trades and to inform decisions, we end up neglecting the contributions from ISR force structure as well as the enabling contributions coming from, or moving through, assets on orbit above us, namely those within the space domain. Capturing the benefits from the effects from space only adds to the complexity of conducting relevant joint warfare analysis at the campaign level. The absence of an ability to integrate space capabilities, and cyber as well, into a joint integrated war fighting campaign has been recognized for a number of years.

As early as 2010, Gen Robert Kehler, the AFSPC Commander at the time, and Gen Kevin Chilton, the commander at USSTRATCOM, noted the deficiency in our analytic work and appealed directly to the Chief of Staff of the United States Air Force, Gen Norton Swartz. The result was a task, originating at CORONA (one of the USAF Four Star Summits), to bring analysis in both the space and cyber domains, up to the level we have conducted analysis of the air domain for decades. Along the way we should correct any flaws in the work done within the air domain in the absence of the space contributions. Planning was done, a roadmap was created, and courses of action were proposed. But the resources to tackle this problem never emerged, in part because the space community believes it is above the fight. The space community has remained isolated from joint integrated campaign analysis for three reasons. First, as mentioned, it is difficult. Any attempt to model information in a war fight always proves elusive. Second, the contributions of space are larger and more contributory to the strategic posture of our county as a whole, rather than just the war fighting or shooting aspects of the war, i.e., when hostilities start. It is argued this value will not be captured in the current methods of campaign analysis that is used by all three services. Third, the space community believes the structure of joint integrated war fighting analysis is hopelessly biased in favor of the other domains. Thus, to join this integrated analysis is to acknowledge that space will never have the same value as an F-35 with JASSM, for instance. It is argued that space is shown a negative bias by an Air Force dominated by individuals who prefer to buy, fly, and operate aircraft. In reality, if the contributions of space were to be accurately represented at the campaign level those contributions would be readily apparent.

Meanwhile, the space community struggles with major complexities of its own. In the face of an increasing demonstration of threats to orbital regimes from potential adversaries, words like "resilience," "disaggregation," and "space campaign" are thrown about fiercely in an ongoing debate. As this future unfolds and the space community clamors to be funded to the levels necessary to build a capability to mitigate this threat to its domain, it has also suc-

cessfully convinced proponents from the other domains to believe that the threat to space is too great, thus, they should cast off any reliance on space, and be funded to the levels necessary to mitigate their own vulnerabilities in this area. For instance, new technology to replace military reliance on our GPS constellation had been a prominent question stemming from an early effort led by Air Combat Command in 2007 entitled, "A Day without Space." Despite a somewhat balanced effort, the outcome of this study served as a direct poke in the space community's eye that confirmed a bias coming from the combat air forces that was intuitively felt. Further, it caused some in the space community to ask with sarcasm, "Will there be a 'Day without Air' study?" In recent days, this continuous tension prompted renewed calls for a separate space service, which had run silent for nearly a decade. Both of these issues raised by the space community inhibit its full participation in the discussion. The issues of bias the community raises can be solved, I believe, with conscientious and accurate analysis at the campaign level.

The challenge to the military operations research community is to come together as a single enterprise to solve these complex issues of analysis. The space community is right to say the value of space to the nation cannot just be weighed in the context of a war fight alone. However, it is not correct that capturing the contributions of space to the operational war fight is not a valid piece of information that decision makers need in their calculus. Nor should they be fearful that its inclusion in the war fight, if accurately represented, would not show a value that would clearly illustrate how iron (air frames and munitions) was traded years ago in favor of a higher probability of kill, ushered in by the advent of precision guided weapons and the Global Positioning System.

In December 2014, the USAF A9 called together members of the space analytic community (AFSPC, USTRATCOM, AFMC, ACC, SMC, and others) to take a hard look at the vision of Gen Kehler and Gen Chilton, and their request to the CSAF back in 2010. This forum is called the Strategic Space Analysis Senior Leader Summit. The effort will attempt to get the analytic community moving back in the direction of integrating space into the campaign war fight. It will attempt to solve the problems of bias, in both the establishment of scenarios to support space analysis and by capturing the effects of space on a war fighting campaign. They will create a framework, based on the Modeling and Simulation (M&S) pyramid that will allow us to show the value of space across all phases of conflict, including Phase 0, ahead of actual hostilities.

OSD and the Joint Staff are correct that the complexity and the resources required for this work are large. But to stick our collective heads in the sand and allow decisions and trades to be made strictly within a service, capability,or resource stovepipe because it is too complex or too uncertain, is to not engage the promise of joint warfare analysis as the important tool described by Mr. Barber. Rather, our analytic legacy will be reduced to a collection of simple tools that confirm the intuitive bias already rampant in our stovepipe acquisition system. Mr. Barber's challenge to the community should be answered. We need to reinvigorate our joint campaign analysis capabilities and double our efforts to add modeling representations of space assets.

Note: *The views and opinions expressed herein are those of the author and do not necessarily reflect the views of the United States Air Force.*

About the Author

Jim "Mooch" Muccio is a career analyst with a degree in mechanical engineering from Texas A&M University and advanced degrees in liberal arts from Texas Christian University and operations research from George Mason University. He was a munitions maintenance officer on active duty in the United States Air Force during the first Gulf War, a systems engineer with the Strategic Defense Initiative in the early 1990s, and is currently a federal civilian conducting analysis on national defense systems for the United States Air Force. He leads the Integrated Space & Cyber Analysis Division for the Headquarters Air Force, Studies, Analyses, and Assessments. From 1994 to 2003 he was the president and CEO of Simulation Support, Inc., an analytic consulting firm doing analysis for the DoD he started with two other engineers. He is an elected member of the Military Operations Research Society (MORS) Board of Directors and is currently chair of the MORS Ethics Committee.

Asking the Right Question: Thoughts on Participating in a Professional Dialogue

Harrison Schramm, MORS Vice President, Member and Societal Services, vpmss@mors.org

MORS special meetings and the annual symposium present our members the opportunity to present their work to other members of the analytic community in an informal setting. Several years ago, I was preparing for a conference to present a paper that I had spent a lot of energy on that was nearly complete. As I was leaving the office for the airport, one of my coauthors said, "I hope we get some good questions."

I was still a junior analyst and didn't quite understand. I thought that the point of giving a presentation was to survive the experience and get off the stage without having to answer any questions at all, save perhaps minor variations on "why is your work so awesome?" Recently, I have realized that we spend a lot of effort telling people how to make good presentations—the transmission side of communication—but we may not be giving appropriate attention to what makes good questions—the feedback part. Although focusing on presentations affects the part of the community that is speaking at any given event, asking good questions is more about the health of the entire analytic community. I've had a few experiences on both sides of the podium that have encouraged me to put some thoughts on the table.

Why Do People Present at Meetings?

There are many reasons that people present their work at conferences in the year 2015, such as justifying their travel, advertising their work/methodology, and building up their resume. But the real reason we should be doing it is for informal, fast peer review. This important step in the research process precedes formal review, either by referees or customers. Questions from the audience are a core reason to have public expositions of our work.

Raising a question during a session makes the asker an uninvited coauthor. When done properly, it aids the presenter with constructive information and both improves and broadens the work. When done poorly, it "barges in" on the presentation. If you are going to commit to stealing some of the presenter's spotlight, you should do it well.

What Makes a Good Question?

In my opinion, a good question acknowledges the effort and contribution of the author and helps push the dialog forward among the community writ large. Be aware that in asking you are communicating both your professional knowledge and, more importantly, your quality as a colleague. A good question should accomplish two things:

- It should help further the research of the presenter, and the session at large.
- It should demonstrate that the asker understands the topic at hand and has paid attention during the discussion. When asked in public, a question should be of interest to more than the asker.

Good questions should be technically based without dwelling on technical details, and hard without being unkind.

Just because you can ask a question doesn't mean that you should. With respect to questions, presentations broadly fall in three categories. First, a presentation can be so airtight that there aren't any meaningful questions to ask. This is rare, because most presenters are showing work in progress. At the other extreme, a presentation can be so bad that there are lots of holes in the work. In this case it is difficult to come up with a productive question to ask, and it is better off not to ask anything at all. The third possibility is that the presentation is of good quality overall, but there are some minor "threads" hanging. Here is where the interaction between the presenter and the audience can be most useful.

What Makes a Bad Question?

The defining trait of a bad question is rudeness, and the overarching rule for audience members is don't be rude in public. It is possible to be technically challenging without being rude. Conversely, it is possible to be rude while carrying no substantive content. Some of the most common ways to be rude are:

- Hijacking the question-and-answer period to give your own minipresentation. If the setup to your question takes more than two minutes or requires multiple references to materials not covered by the speaker, you are probably crossing the line between asking about a presentation and giving your own. The warning signs that you are doing this include other attendees checking their watches and the speaker or chair responding with "I don't think that was a question."
- Overly dwelling on technical detail. This is when you give the impression that you are getting ready for a "nerd off" with the speaker. Technical questions are good and proper, but in public they should not be strictly for technicality's sake. The technical point raised should substantially affect the outcome of the analysis. Lesser technical points are best raised in private afterward (see below).
- A question that is driven by personal or organizational differences is always rude. Open forums are not appropriate for airing grievances against another's personality, method, or institution. It is the job of the organizers to vet participants, and if you really have that much of a disagreement, this is a discussion to have with the chair afterwards.

When to Ask Questions

Finally, I'd like to address the appropriate time to ask questions. There are three times that people ask questions during a presentation, listed in order from most to least disruptive.

- During the presentation, or the "ambush" question. This is acceptable only if the or chair or speaker indicates, vocally or by body language, that it's okay.
- During the Q&A period immediately following the session. If there is more than one hand up during the question period, take a quick

second and ask yourself if anyone other than you will be interested in the discussion. If not, you should probably ask the question privately after the presentation.

- In private afterward, in person or via email. If there's a problem with slides, or methodology, or after viewing the work you want to delve into technical points, an email afterward is a good mechanism for sharing your concerns. This allows the feedback to be given without causing embarrassment for either the speaker or yourself. The speaker, and the community writ large, will think that you are a well-behaved analytic citizen.

Special Situations

Before concluding, I'd like to address two special situations.

- If you are chairing a session, you should be prepared to ask a question if none of the audience members do. This prevents five minutes of awkward silence where the speaker wonders if anyone was actually listening.
- First question in a large setting where you are relatively senior. In this circumstance, your question sets the tone for the rest of the discussion, and requires a little bit of forethought. Your question will set the tone, and encourage—or possibly derail—the rest of the discussion.

Finally, if you find yourself needing to ask a question but unable to think of a good one, I find computational complexity and runtime are almost always safe and interesting. Either the solution is fast and allows the speaker to highlight how elegant his or her method is, or it is slow and complex, and allows the speaker to talk about how he or she overcame those challenges.

Feel free to email me some questions about asking good questions at vpmss@mors.org.

MORS Heritage Pages 2005–2007

As we continue the countdown to the 50th Anniversary of MORS, we would like to revisit our proud history and highlight the past leaders of the Society and key accomplishments over those years. Each edition of *Phalanx* will provide insight into several years of history. Enjoy reading about these individuals and what they have accomplished. More information on the Past Presidents (PP) can be found on the MORS website, including their oral histories.

Elected Directors (consolidated list 2005–2007)

Dr. Patrick Allen
Lt Col Andrew Armacost
Donald Bates
Col (s) Suzanne Beers, FS
Dr. Ted Bennett Jr.
Joseph Bonnet
Mary T. Bonnet
Dr. W. Forrest Crain
Col Gerald Diaz
Lawrence Dick, FS
William Dunn, FS
Helaine Elderkin, FS
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John Ferguson
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Lt Col Peter Vanden Bosch
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Helaine Elderkin, FS,
Counsel
Col John Andrews, USAF,
Editor, Phalanx
Dr. Richard Deckro,
Editor, Military Operations Research (MOR) Journal

Significant Events

August 2002: MORS President, Edward Smyth, represented MORS at the 19th International Symposium of Military Operational Research (ISMOR) conducted at Eynsham Hall near Oxford, UK. In addition to briefing ISMOR on MORS activities, an invitation was extended for ISMOR members to publish in *Phalanx* and to attend unclassified MORS special meetings.

2002: MORS also gained permission from UK officials to republish a book entitled *Operational Research in the RAF* as another volume in the MORS Heritage Series of publications.

September 2002: The MORS office moved from the Duke Street location to the office suite on N. Beauregard Street.

2002: The Educational Forum went "on the road" for the first time. It was held at the Naval Postgraduate School (NPS) with a number of West Coast civilian schools in attendance. Mike Garrambone served as the program chair for the event that featured a team competition for students in attendance.

2002–2003: Formed an ad hoc committee of the Board of Directors (BoD) under the leadership of Lana McGlynn to review the existing Composite Group/Working Group structure. Changes to the structure were implemented during the 72nd MORSS in 2004.

2002–2003: MORS BoD members were tasked with reviewing and recommending changes to the MORS Electronic Media Committee to expand MORS interactions with the rapidly expanding suite of desktop and laptop automation capabilities of MORS members.

2002–2003: Implemented the Sponsor Hot Topics segment of the annual Symposium beginning with the 71st MORSS.

2003: Implemented the Sponsor's Corner in *Phalanx* in which the MORS sponsors write articles on various topics, starting with Jackie Henningsen in June 2003.

74th MORS Symposium, United States Air Force Academy, Colorado Springs, June13–15, 2006. *40 years Foundation for the Future.* Lawrence L. Dick and Susan M. Iwanski were inducted as Fellows of the Society. Dr. Roy E. Rice, FS received the Wanner Award. Stephen J. Balut received the Thomas Award. David Briggs received the Walker Award. Donald Buckshaw, Dr. Gregory Parnell, FS, Willard Unkenholz, Donald Parks, James Wallner, and O. Sami Saydjari received the MOR Journal Award.

75th MORS Symposium, US Naval Academy, Annapolis, Maryland, June 12–14, 2007. *Through Multiple Disciples, Analytical Power.* Royce H. Reiss and Dr. Cyrus J. Staniec were inducted as Fellows of the Society. Walter W. Hollis, FS, received the Wanner Award. Jerome J. Bracken received the Thomas Award. Gregory Boylan, Bobbie L. Foote, and Roger Burk received the Walker Award for their article, "Loitering Aircraft as a Capability Added for Anti-Ballistic Missile Systems" *Phalanx*, Volume 39, Number 1. Dr Patrick J. Driscoll and MAJ Steven J. Henderson received the MOR Journal Award.

MORS Presidents

40th MORS President: Suzanne Beers, 2005–2006

Suzanne Beers served as Secretary in 2001–2002, Vice President for Meeting Operations in 2002–2003, Vice President for Finance and Management in 2003–2004, and President-Elect in 2004–2005. She served as MORS President from 2005–2006. She was elected as a Fellow of the Society in 2010.

Dr. Beers holds BS degrees in physics from Miami University and mechanical engineering from the Ohio State University, an MBA from New Mexico Highlands University, an MS in electrical engineering from the New Mexico State University, and a PhD in electrical engineering from the Georgia Institute of Technology.

Dr. Beers is a retired United States Air Force Colonel. She was Commander, US Air Force Operational Test and Evaluation Center's Detachment 4. During her Air Force career, Dr. Beers held assignments in which she developed and integrated cruise missiles; operationally tested and evaluated cruise missiles, satellites, and space control centers; analyzed space systems; operated ground-launched cruise missiles; and led groups in acquisition, operations, and testing.

Dr. Beers joined the MITRE Corporation in Colorado Springs, Colorado in 2008, supporting DOT&E's Space and Net-Centric Systems. In 2009, she began working in support of DASD(DT&E) to help improve how DoD conducted Developmental Test and Evaluation. She developed the Developmental Evaluation Framework—a means to focus DT&E strategy development on evaluating the system and informing decisions. The DEF idea has been adopted by DASD(DT&E) as the means to implement the Shift Left initiative, to meet OSD/AT&L Better Buying Power. She was recently selected as MITRE T&E Portfolio Manager, responsible for managing MITRE's OSD T&E business portfolio.

41st MORS President: Patrick McKenna, 2006-2007

Mr. Patrick McKenna served as Vice President, Professional Affairs in 2003–2004, Vice President for Meeting Operations in 2004–2005, and President-Elect in 2005–2006. He was President of MORS in 2006–2007and was elected a Fellow of the Society in 2009.

Mr. McKenna earned a bachelor's of science degree in industrial and management systems engineering from North Dakota State University and a master's of science in industrial and systems engineering from the University of Nebraska, Lincoln.

Mr. McKenna is currently senior advisor to USSTRATCOM's J5 Plans and Policy Group. He has served as the chief of the Capabilities Analysis Branch, Analysis Management Division, Resource and Requirements Directorate United States Strategic Command.

Mr. McKenna has received numerous awards during his career, including Air Force Civilian Analyst of the Year (1998) and the Joint Meritorious Civilian Service Award (2004).

MORS' Young Analysts
The Next Generation of Leaders

The future of operations research and the national security community depends on new analysts taking the helm. MORS' Young Analyst Initiative facilitates this process by providing paths for emerging analysts to engage with MORS through publishing, meeting participation, volunteering, mentorship and recognition.

To highlight the achievements, interests and aspirations of young analysts, we turn the spotlight on one deserving individual in every issue of *Phalanx*.

To learn more about the Young Analyst Initiative, connect with other young analysts, see past featured analysts and learn how you can nominate a deserving analyst, please visit

www.MORS.org/YA

Alexander Trempe

What was your childhood ambition?

As a child/teenager I had two completely different goals for my future career: to become an orthopedic surgeon, or a spy. Given my history of sports injuries I was drawn to the doctors who helped patch me up and allow me to get back to athletics as quickly as possible. I thought that it would be fun and interesting to be able to provide a similar service to people in the future. The fact that my doctor drove a Lamborghini didn't hurt either. My other dream to be a spy was borne from the countless fiction books I read by authors like Tom Clancy and Robert Ludlum. I liked to envision myself working to defeat the adversaries of the United States across the world. It's somewhat amusing then, that in the end I find myself in a field where my daily actions ensure that the US Navy has the investments necessary to provide future security around the world.

Why did you become an operations analyst?

I began my professional career as a junior analyst specializing in campaign modeling and simulation. I quickly realized that I was more interested in applying analytic techniques to the data and results from the modeling rather than puzzling my way through methods and techniques to instantiate objects in the model. It was at this point that I began to increase my analytic training and experience. I focused on methods to easily incorporate quantitative values to senior leaders. It is thrilling for me to tease out insights from data that then further advances the goals of the Navy.

Where do you see yourself in five years?

Using my operations research skills, and my experience as a Navy analyst, I believe that I can step into a senior leadership role within the Navy or the Department of Defense within the next five years.

How has MORS benefited you? What do you value most about your experiences with the Society?

Although I am not currently a member of MORS, my association with the Society has been extremely beneficial. I have attended multiple MORS symposiums over the years and had the opportunity to present some of my work at the 2014 symposium. The exchange of ideas, insights, and analysis techniques at the MORS symposium has been invaluable to my development as an operations research professional.

PuzzlOR

THINKING ANALYTICALLY

John Toczek

¢oins

Rearrange the coins above so that the sums of the coins across the rows and down the columns match the dollar amounts shown.

			$0.11
			$0.12
			$0.25
$0.21	$0.16	$0.11	

Question: In what order do the coins need to be to solve the puzzle?

Send your answer to puzzlor@gmail.com by April 15, 2015. The winner, chosen randomly from correct answers, will receive a $25 Amazon Gift Card. Past questions can be found at puzzlor.com.

John Toczek is the Sr. Director of Decision Support and Analytics for Aramark Corporation in the Global Operational Excellence group. He earned his BSc. in chemical engineering at Drexel University (1996) and his MSc in operations research from Virginia Commonwealth University (2005).

Member Milestones

Andrew W. "Andy" Marshall retired January 2, 2015, from his position as the Director of Net Assessment in the Office of the Secretary of Defense. Mr. Marshall founded the Office of Net Assessment in 1973 and was known for his "out of the box thinking" on hard topics. His advice was heeded by Secretaries of Defense for more than five decades. Mr. Marshall received the MORS Vance R. Wanner Memorial Award in 2010. His oral history will be published in the MOR Journal, Volume 20, Number 1 (see http://www.mors.org/Publications/MOR-Journal).

Four long-time members of MORS have been selected as Fellows of the Society by the Board of Directors at the December meeting. They are **Arthur H. (Trip) Barber, Dr. John R. Hummel, Lana E. McGlynn,** and **Terrance J. (Terry) McKearney.** Look for more information on these new Fellows and the role of Fellows in MORS on page 9.

Kirk Michealson, FS, was invited to a VIP tour of the Golf Channel by the research director, who is responsible for the channel's business analysis functions. The Golf Channel was celebrating its 20th anniversary during the visit and asked Kirk to be part of its photomontage for the "Morning Drive" show. The accompanying photo substantiates this, so we know it's not just another false golfer's claim.

Kirk Michealson, FS, is a new star on the Golf Channel.

Ben Taylor of the Defence Research and Development Canada/Centre for Operational Research and Analysis (DRDC/CORA) is now the Canadian representative to MORS Board of Directors, replacing Dr. Roy Mitchell. Ben has served in the British Ministry Defence as well as the Canadian government.

MORS President **Dr. Raphael Matos** has been again invited as guest lecturer of the Mathematics Department of the Indiana University of Pennsylvania (IUP) in February. He will be presenting two workshops on effective visual presentation of data entitled, "Do you SEE what I'm SAYING." These will take place on February 27 at the IUP.

Gene Visco, FS, keeps busy on the lecture circuit, presenting two "brown bag" talks in December and January. In December, he addressed the MORS War Gaming Community of Practice (COP) on Schnellspiel, a hand-played war game he built in 1963 for NATO's Central Army Group. In January, Gene spoke to the Lockheed Martin Operations Analysis COP on "How Operational Research Crossed the Pond and Became Operations Research," a topic he covered in a *Phalanx* a few months ago).

Dr. Richard Goodwin will receive the Silver Beaver award, the highest award that the Boy Scouts of America bestows on its adult leaders in March. The award was introduced in 1931 and is given to adult Scout leaders who have made an impact on the lives of youth through service given to the council. Dr. Goodwin will receive this honor as a long-standing, lifelong supporter of scouting programs and for his "extraordinary leadership and cheerful service." at all levels of Scouting in Councils such as the National Capital Area Council, Mid America Council, and Greater Alabama Council.

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The Pseudo-Analytical Agenda

Saved by the DODAF

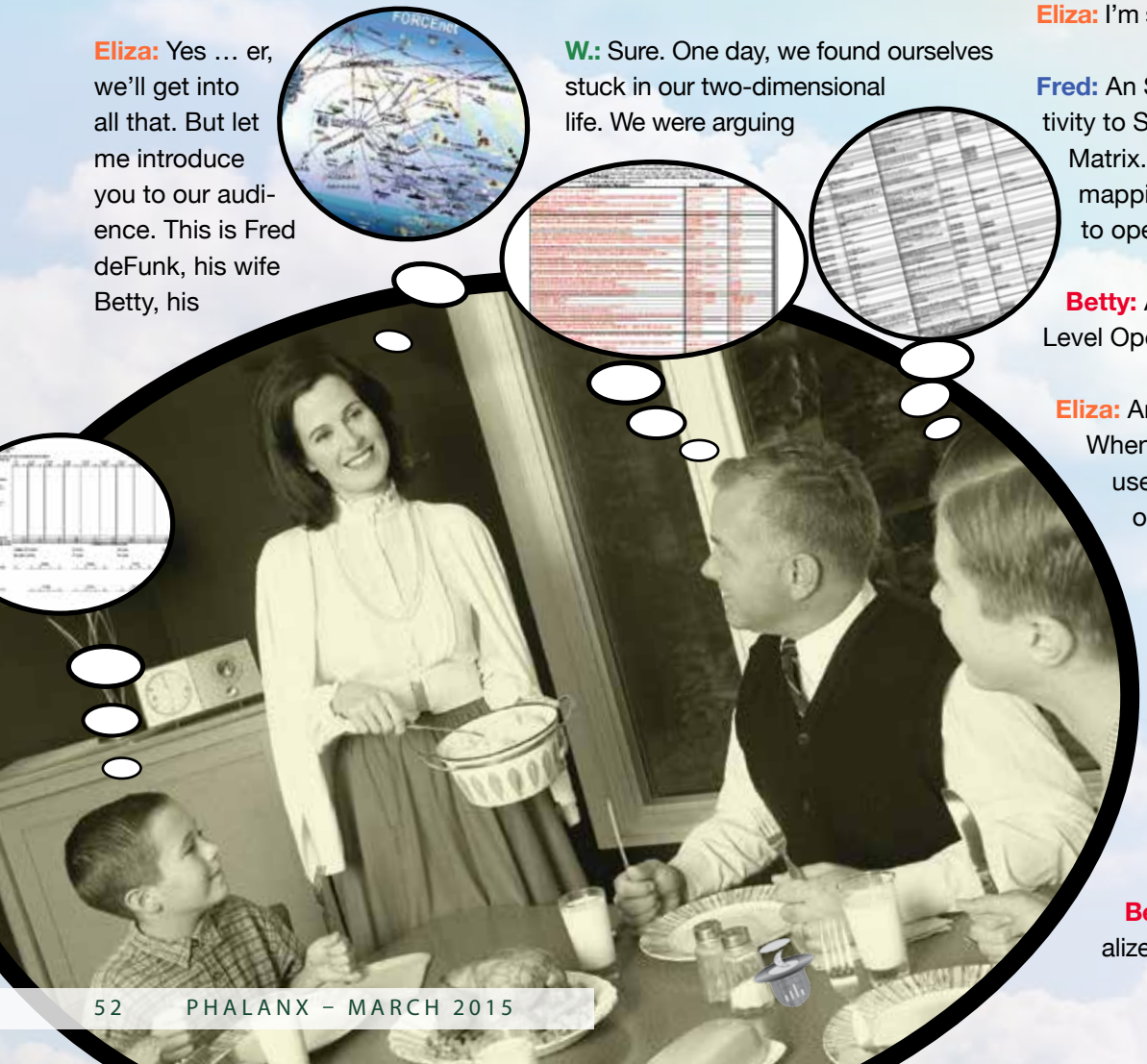
Or, How One Family Cured Their Dysfunctions through Reference Architectures

Eliza: Hi, I'm Eliza Faddish reporting for Channel 2.02. I'm here today with the deFunk family, who have an interesting story about how systems engineering helped them get it together.

Fred: Actually, I'd say we just weren't achieving our Desired Effects!

Betty: I'll say! No visions or measures … we couldn't even agree on our as-is Organizational Activity Model!

Eliza: Yes … er, we'll get into all that. But let me introduce you to our audience. This is Fred deFunk, his wife Betty, his daughter Wilma, and little Fred Jr.



Wilma: W. Not Wilma. I'm now a performer and I've declared a Person Type with a defined role with respect to the Architecture. As such, I am now called "W."

Eliza: Well thank you … W. Maybe you'd like to start as to how your family came to embrace this new way of doing things?

W.: Sure. One day, we found ourselves stuck in our two-dimensional life. We were arguing about who should take out the garbage and why I shouldn't be allowed to plug in my earbuds at the dinner table. And Fred Jr.'s room was a disaster—again.

Fred Jr.: That's not fair! We decided that I was never given enough training on the Zachman Framework Interrogatives to put together an SV-5a! And who can clean their room without an OV-1?

Eliza: I'm sorry—what are these things?

Fred: An SV-5a is the Operational Activity to Systems Function Traceability Matrix. [ELIZA stares] You know, a mapping of system functions back to operational activities.

Betty: And an OV-1 is The High-Level Operational Concept Graphic!

Eliza: And how did these help? When I was little, my Mom just used to say "Clean that dump of a room or else I'm gonna take everything I find on the floor and burn it!"

Fred: People say that sort of thing to us all the time. But they just don't understand that our kids are crying out for High-Level Data Constructs!

Betty: That's right, Eliza. We realized that it was unfair to expect

Fred Jr. to transform inputs to outputs or induce state changes without a data-based Architectural Description! Let us show you what we mean!

[They all walk down to Fred Jr.'s room. Inside, the room is bare except for a bed, a desk with a laptop on it, and a desk chair. The walls, however, are covered with flow diagrams.]

Eliza: Wow. This room is … clean. Where's the, ah, OV-1 and SV-5a?

Fred Jr.: Well, you silly, you're not allowed to start with that! Come over here and look at the deFunk DIV-1!

Eliza [staring at a large diagram near the door]: And what's the DIV-1?

W.: Everyone knows what that is! It's the DM2 Conceptional Data Model! See, look at this. You've got Guidance, made up of Rules, and they have Standards and Agreements! Then we've got all the Activities—and you know those have got to be performable, or you're just wasting organization cycles—then we've got the Capabilities, and finally, the Resources and Performers!

Eliza: And you've taken all the family chores and laid them out like this?

Betty: Not just chores! We do all our activities like this now!

Fred: Including recreation [blushing]—but some of those are classified.

Eliza: Well what if someone wants to do something new or different?

W.: There's nothing really new, because we use the IDEAS Ontology, which separates Things into Individuals that have 4D spatial-temporal extent. Then there's the Types, which can be classified using Naïve Set Theory or Type Theory, and Ordered-Relation Tuples. Plus, we've got the basic Set Theoretic, Mereologic, and 4D Topologic relationships. Name me something that can't fit into that!

Eliza: Well … I guess I can't.

W.: You see? Any time anything comes up, we take it from Free-text to Structured Document to Database to Mathematically Structured, and we're rolling!

Fred: And then we can generate the Meta Model, and start in on the Viewpoints!

Eliza: Viewpoints? I'm getting the impression there's no room for alternative viewpoints.

Betty: No, no, we're not talking about different opinions! We're talking about representing the capability as it flows through the deFunk Enterprise!

Fred Jr.: Yeah, you know, the Capability Viewpoint, the Data and Information Viewpoint, the Operational Viewpoint, the Project Viewpoint, the Services Viewpoint, the Standards Viewpoint, and the Systems Viewpoint! Me, I like the Standards Viewpoint.

Eliza: I'll bet you can't say all those again.

ALL [in unison]: Capability Viewpoint, the Data and Information Viewpoint, the Operational Viewpoint, the Project Viewpoint, the Services Viewpoint, the Standards Viewpoint, Systems Viewpoint!

Eliza: And a Partridge in a Pear Tree. So … tell me, was it hard to make this a part of your everyday life?

Fred: Well, I'm a Chief Information Officer, so I do this all the time at work. But my family did think it was a bit crazy at the start.

Fred Jr.: Yeah, we didn't believe Dad actually got paid for this. We thought he was like the guy on *Breaking Bad,* who pretended to have a job while he was making crystal meth.

Betty: I became a believer when I started using it down at the bridal shop.

Eliza: OMG … and how do you use this there?

Betty: Well, these days, we have more and more bridezillas come in, and their mothers—don't even get me started on that. That's one group that the ontology probably can't handle. But anyway, when I sit them down and make them write out a PV-3, the bad ones go out the door and never come back!

Eliza [signaling to camera that this is about to end]: And what's a PV-3?

Betty: Why, it's a Project to Capability Mapping—a mapping of programs and projects to capabilities to show how the specific projects and program elements help to achieve a capability! And believe me, these girls nowadays have no idea how to achieve a Desired Effect under Specified Standards and Conditions through Combinations of Ways and Means to perform a set of Activities!

Fred [beaming]: That's my wife—she's at the top of my little Meta Data Registry!

Eliza: And this is Eliza Faddish, reporting on the deFunks for Channel 2.02. If you're interested in the deFunk approach, check out http://dodcio.defense.gov/TodayinCIO/DoDArchitectureFramework.aspx today.

52nd Army Operations Research Symposium: Analyses Supporting a Leaner, More Capable Expeditionary 2025 Army

Holly Costanzi, US Army Materiel Systems Analysis Activity, holly.m.costanzi.civ@mail.mil

The 52nd Army Operations Research Symposium (AORS), sponsored by the US Army Materiel Systems Analysis Activity (AMSAA), was held for the first time at the Communication-Electronics Command Mallette Training Facility at Aberdeen Proving Ground, Maryland, on November 4–5, 2014. The theme for the 52nd AORS, "Analyses Supporting a Leaner, More Capable Expeditionary 2025 Army," reflects the importance of analysis to enable the Army to meet the demands for a leaner, smarter, more lethal, and flexible Army while having the ability to operate, enable forces, and organize differently.

AORS is the preeminent operations research analysis professional development event at which Army junior military and civilian operations research analysts interact with senior analysts, general officers, and members of the Senior Executive Service. The purpose is to provide the Army's internal analytic and research organizations with the opportunity to highlight recent analytical breakthroughs. The conference provides a forum for sharing information and experience gained from ongoing and recently completed operations research projects. Recent AORS have focused heavily on analytical support to deployed operational commander at the tactical, operational, and strategic levels. The result is a more professional

A senior leader panel session was conducted at the morning plenary session on November 5 and included Dr. William Forrest Crain, Director for the Center for Army Analysis, Ms. Pamela Blechinger, Director of the US Army Training and Doctrine Command Analysis Center, Mr. James Amato, Director of the US Army Materiel Systems Analysis Activity, and Mr. David Jimenez, Director of the US Army Evaluation Center.

operations research community, with a greater appreciation of how quantitative analysis can be used to solve difficult problems, and a cohesive community that can more effectively meet the Army's analytic demands in the years to come. AORS consists of two presentation formats: plenary sessions devoted to invitational presentations and concurrent working group sessions devoted to technical presentations. AORS includes the presentation of the Army's prestigious Dr. Wilbur B. Payne Memorial Awards for Excellence in Analysis during a plenary session, and the Operations Research/Systems Analysis (ORSA) Hall of Fame Banquet, which features the induction of historically distinguished Army operations research practitioners into the ORSA Hall of Fame.

Mr. James Amato, Director of the US Army Materiel Systems Analysis Activity presents keynote speaker Mr. John Nerger, Executive Deputy to the Commanding General of the US Army Materiel Command with a coin and Certificate of Appreciation at the 52nd Army Operations Research Symposium on November 4, 2014.

Mr. James Amato, Director, AMSAA, commenced the AORS by welcoming the Army's analysts and noting that in the history of AORS, this was the first time it was held at the Aberdeen Proving Grounds. He emphasized that the symposium provides a forum for sharing information and experience, broadening the perspective of the Army's analytical community, and exposing analysts to a variety of operations research methods. COL Mark Lukens, AMSAA's Military Deputy, served as emcee, and welcomed the AORS distinguished guests. In attendance were keynote speaker Mr. John Nerger, Executive Deputy of the Commanding General (EDCG),

SPONSOR'S CORNER

US Army Materiel Command (AMC); Mr. Gary Martin, Executive Deputy to the Command General of the US Army Communications-Electronics Command, who provided welcome comments; and members of this year's senior leader discussion panel: Dr. William Forrest Crain, Director, Center for Army Analysis (CAA), Ms. Pamela Blechinger, Director, US Army Training and Doctrine Command Analysis Center (TRAC), Mr. James Amato, Director, AMSAA, and Mr. David Jimenez, Director, US Army Evaluation Center (AEC).

Other distinguished guests included Mr. Donald Tison, Assistant Deputy Chief of Staff (CoS), G-8; Mr. Robert Carter, Executive Technical Director, US Army Test and Evaluation Command (ATEC); Dr. Paul Tanenbaum, Director, Survivability, Lethality Directorate, US Army Research Laboratory; Dr. Garrett Lambert, Director, TRAC, White Sands Missile Range (WSMR); Dr. Steven Stoddard, Technical Director, CAA; Dr. Paul Deitz, Senior Analyst, AMSAA; and Mr. Phil DiSalvo, Acting Technical Director, AMSAA.

Mr. John Nerger, EDCG of AMC, provided the AORS keynote speech during the November 4 plenary session. In keeping with the theme of the 52nd AORS, Mr. Nerger spoke about today's challenges with respect to shrinking budgets and continued unpredictable threats. He stressed that with respect to the Army, analysts have a mission that matters and analysis is more important now than in recent history. Mr. Nerger concluded with his thoughts on the Army profession and the importance of civilians, and reflected on what it takes for civilians to be leaders.

During the plenary session, Mr. Nerger presented the Wilbur B. Payne Memorial Awards for Excellence in Analysis. The winner of the Wilbur B. Payne award is decided by the Army's Deputy CoS, G-8, and is awarded in two categories for small and large Army OR organizations. This year, winners from 2013 and 2014 were acknowledged. For 2014, in addition to the small and large group winners, there were presentations for two additional categories, special and assessment. Mr. Nerger presented awardees with a Headquarters Department of the Army (HQDA) plaque, and a certificate of achievement signed by the Honorable John M. McHugh, Secretary of the Army.

The 2013 small group winner was AMSAA for its "Multi-Function Electronic Warfare Analysis of Alternatives Performance and Risk Study." This study identified

and examined a set of electronic warfare alternatives across six system variants by developing a methodology to identify the key technology drivers in the areas of performance and schedule risk. The effort provided critical input that addressed the study guidance and provided senior leaders the information needed for a fully informed acquisition decision.

The 2013 large group award went to the "Aerial Reconnaissance and Surveillance Mix Study," performed by the US Army TRADOC Analysis Center. The team developed an Army aerial intelligence, surveillance, and reconnaissance resourcing strategy to inform the fiscal years 2015–2019 Program Objective Memorandum (POM). Their complex, innovative effort eclipsed the scope of all previous analyses in this warfighting function and provided the Army with a foundation of analytic evidence to underpin future Army resourcing decisions regarding aerial platforms and associated sensors. The TRADOC Analysis Center, TRAC-Ft. Leavenworth (FLVN), TRAC-WSMR, AMSAA, and the Naval Postgraduate School received organizational and individual awards.

The 2014 small group award went to the US Army TRADOC Analysis Center for recognition of its work, "Army End Strength Analysis—Analysis Supporting Army End Strength Reduction Decisions." The study examined Army end strength reductions across a variety of conditions and potential futures. The innovative approach enabled a robust examination of options, risks, and costs that supported an Army decision on end strength, numbers of brigade combat teams, and force composition. This analysis provided an objective, defensible analytic foundation for the Army to preserve its capabilities and meet the nation's demands.

The US Army TRADOC Analysis Center also received the 2014 large group award for its work, "Operational Energy Analysis: New Approaches to Analyzing Sustainment." The team developed an innovative approach to analyzing operational energy that produced the first credible and robust analytic methods linking sustainment impacts operational outcomes. This groundbreaking effort armed senior leaders with critical evidence supporting ongoing Army modernization efforts in a challenging, resource-constrained environment.

Organizational as well as individual awards were received by the TRADOC Analysis Center, TRAC-Ft. Lee, TRAC-WSMR, TRAC-FLVN, the TRADOC Intel-

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ligence Support Activity, and the Logistics Innovation Agency.

The 2014 special category award was presented to AMSAA for recognition of the work, "Field Deployable Hydrolysis System (FDHS) Risk Reduction and System Enhancement Study." The analysis directly shaped operational constraints, produced operator risk tables as a function of sea state for FDHS operation by the Army Vessel *Cape Ray*, and made direct system changes that significantly reduced risks to operators and the mission. The team analyzed critical system attributes which resulted in a decision to move forward with the FDHS. These enhancements, developed with significant analytical rigor, directly shaped operational constraints for this critical project, and are now part of FDHS system design and operating procedures. Individuals receiving this award were from AMSAA and the US Army Edgewood Chemical Biological Center.

The CAA received the 2014 assessment category award for recognition of work on the US Security Coordinator for Israel and the Palestinian Authority Security Forces Assessment Study. This study contributed directly to the US Security Coordinator mission to employ the correct balance of quantitative analysis for a complex assessment of the Palestinian Authority Security Forces. The team's work supports and informs a wide range of US Security Coordinator processes and decisions.

Presentations from the HQDA Army Study Program Management Office, the Functional Area 49 Operations Research/Systems Analysis Proponency Office, and the Career Program 36 Occupational Series 1515 Operations Research Analyst Civilian Management Office concluded the plenary session. The following day, a senior leader panel session addressing opportunities and challenges facing operations research analysts along with a question and answer session, rounded out the large group sessions.

The afternoon schedule of AORS on November 4 and 5 consisted of nine breakout sessions: seven permanent working groups focusing on enduring topics that have proved to be constant areas of analysis focus over the past decade, and two topical working groups that are chosen to address the most relevant and time-sensitive issues presently confronting Army analysis. The enduring working groups topics are advances in OR and technology; current operations; force development; future capabilities;

On the evening of November 4, the Operations Research/Systems Analysis (ORSA) Hall of Fame banquet was held at the Richlin Ballroom. The 2013 and 2014 winners of this prestigious award were inducted into the ORSA Hall of Fame. Pictured above from the left are GEN (Ret) David M. Maddox (2014), Mr. E.B. Vandiver (2013), Dr. James Streilein (2014), and Mr. Michael F. Bauman (2013).

resource analysis; sustainment; and manpower, personnel, and training. This year's topical working group sessions focused on operational energy and readiness analysis. A total of 118 OR-related technical papers were presented during these working group sessions.

The 52nd AORS included an ORSA Hall of Fame banquet on the evening of November 4. Mr. Walter W. Hollis, the former Deputy Undersecretary of the Army for Operations Research, chartered the ORSA Hall of Fame in March 2004. The ORSA Hall of Fame honors those individuals who have contributed significantly to US Army operations research and systems analysis over a sustained period of time. Honorees have significantly impacted US Army operations research and systems analysis through doctrinal or technical accomplishment and innovative development and have demonstrated outstanding personal leadership and noteworthy achievements that inspired others in the field of OR. The charter of the ORSA Hall of Fame names the AMSAA at Aberdeen Proving Ground, Maryland, as its permanent location. The ORSA Hall of Fame is governed by a board of directors representing the leadership of the major analytic entities of the Army, who each year reviews the nominations and votes to induct up to two inductees. Because AORS was cancelled in 2013 due to sequestration, this year's banquet honored the 2013 and 2014 inductees. The 2013 inductees were Mr. E.B. Vandiver III and Mr. Michael F. Bauman. The 2014 inductees were GEN (Ret) David M. Maddox and Dr. James Streilein.

The Last Word

Some Thoughts on Working with the International Community

Jim Bexfield, FS

This is not an analytical article. It does not tell you about a new technique, inform you of educational activities, describe an event that occurred in another country, or express a viewpoint on the usefulness of campaign models to inform military decisions (an area where I have strong views). But, it does, I hope, provide some perspectives that will help us deal with increasing interactions with analysts in allied countries. Helping them build their analytical base could lead to better decisions within their governments, making all of us safer.

Over the past few years I have had the pleasure of working with the international community in many different forums, ranging from leading a major NATO activity with members from more than 20 countries while still in the government, to twice teaching a military modeling course in Singapore to analysts from Brunei, Malaysia, and Singapore, to a project that supports the Lebanese Armed Forces in Beirut. These experiences have led to some personal observations that may prove useful as MORS seeks to expand its interactions with the international community.

An initial observation that strikes me regarding military professionals from other countries is that most of those who do not have English as their native tongue speak multiple languages. Most Lebanese officers speak and write Arabic, English, and French, and one officer I worked with speaks nine languages fluently. Most Europeans and Afghans I encountered speak multiple languages. They welcomed the praise I provided regarding their ability to speak multiple languages, which helped build rapport.

Almost without exception, the internationals I've worked with were anxious to tell me about their job, culture, views of the world, and complaints against their government. Some had fought in civil wars, others had flown MIGs, and still others lived in a country

where they feel they must go abroad to have fun and shop for nice things. The legal systems, educational systems, traffic, and financial systems often vary significantly. When you buy a car in Singapore you pay a tax equal to the price of the car. This tax is good for 10 years and then must be paid again. Needless to say, there are few cars over 10 years old in Singapore. In Lebanon you see a lot of partially built homes as the homeowner initially saves enough to buy the land, then a year later has saved enough to build the foundation, and then, in another year added savings enable the building of the first floor. This incremental approach continues until the project is completed. Comprehending these differences allows one to better understand how they communicate which, in turn, helps us appreciate the points they are making during our professional interactions.

Finally, most of the internationals I've encountered are anxious to learn from us. Often this learning best occurs initially with oral communication, but to ensure understanding it is often best to write down what you believe you've heard and ask them to comment. This often results in another oral exchange and eventually a common view of the concept. The opposite works well, too, where the foreign national military professionals I've worked with write their view of the concept or process and then you suggest changes to clarify language. In all my interactions they have been appreciative of well thought-out feedback that helps them explain a concept to their peers.

About the Author

Jim Bexfield became a consultant after retiring from OSD/CAPE in April 2012. Earlier positions included 13 years at the Institute for Defense Analyses and 23 years in the Air Force. He was president of MORS from 1983–1985, was elected a Fellow of the Society in 1993, and received the MORS Vance R. Wanner Memorial Award in 1994.

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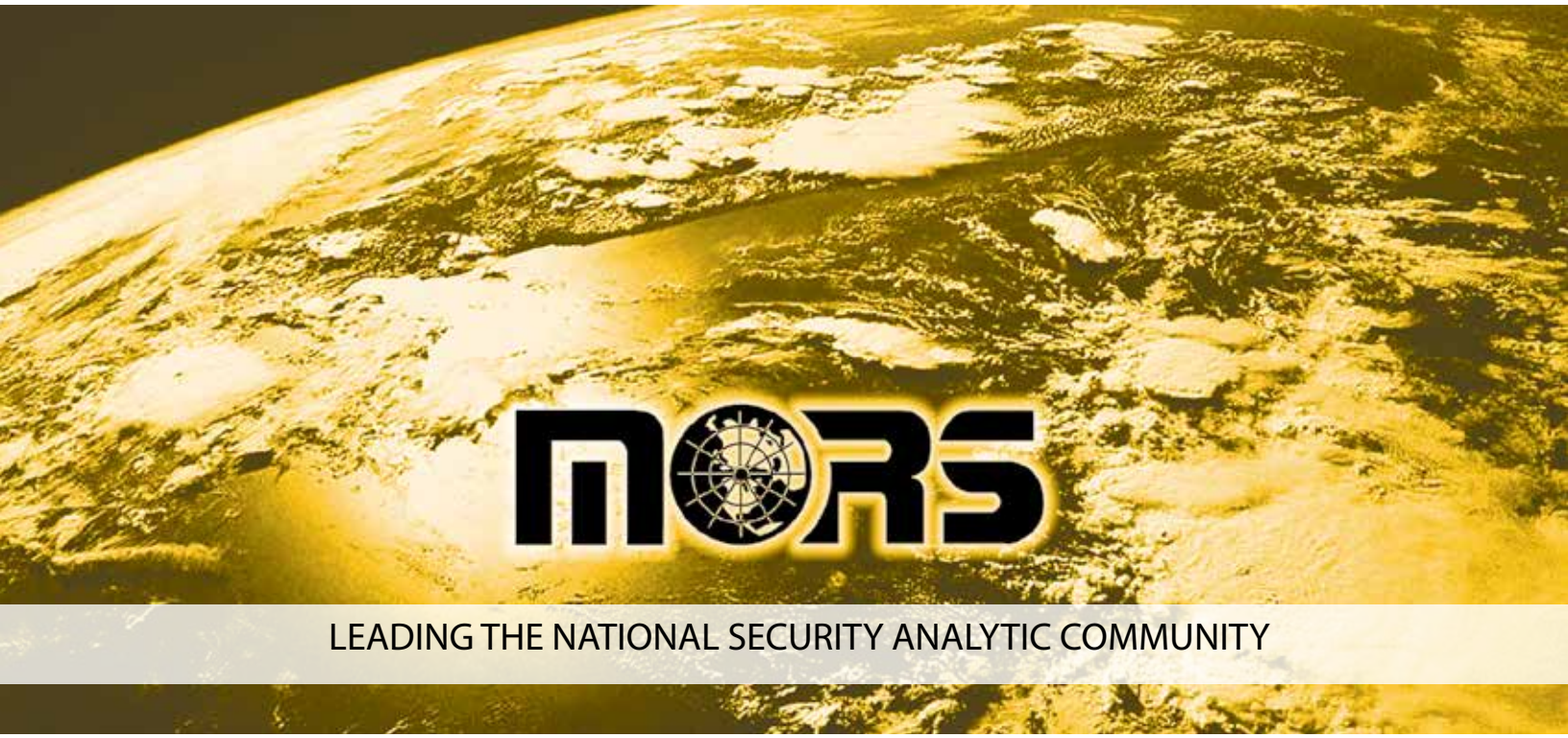

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